# CHAPTER 3

# 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes the existing environment for various resource types and the potential environmental consequences resulting from installation of an FGD system (scrubber) on PAF Unit 3. The FGD system for Unit 3 would be an addition to an expansive heavy industrial facility having a significant property buffer. The plant areas proposed for installation of the FGD components have been heavily disturbed by previous plant development activities. No new facilities would be required to unload equipment transported to the site. As a result, the potential would be small for on-site construction impacts to terrestrial ecology, aquatic ecology, noise, land use, air quality, visual aesthetics, and archaeological and historic resources.

Operational impacts are primarily dependent upon the engineering features and safeguards included in the design of the FGD system (e.g., use of on-site waste disposal area and treatment and control measures for waste streams) and the environmental commitments. These features and safeguards would minimize the probability and extent of release of pollutants to the environment.

## 3.1. Air Quality

### *3.1.1. Affected Environment*

Air quality is an environmental resource value that is considered important to most people. Through its passage of the CAA, Congress has mandated the protection and enhancement of our nation's air quality resources. National Ambient Air Quality Standards (NAAQS) for the following criteria pollutants have been set to protect the public health and welfare:

- sulfur dioxide ($SO_2$)
- ozone ($O_3$)
- nitrogen dioxide ($NO_2$)
- particulate matter whose particles are <= 10 micrometers ($PM_{10}$)
- particulate matter whose particles are <= 2.5 micrometers ($PM_{2.5}$)
- carbon monoxide (CO)
- lead (Pb)

A listing of the NAAQS is given in Table 3-1.

**Table 3-1. National Ambient Air Quality Standards**

| Pollutant | Primary[a] | Secondary[b] |
|---|---|---|
| Sulfur Dioxide | 0.14 parts per million (ppm) (365 micrograms per cubic meter [μg/m$^3$]) maximum 24-hour concentration not to be exceeded more than once per year.<br>0.03 ppm (80 μg/m$^3$) annual arithmetic mean. | 0.5 ppm (1,300 μg/m$^3$) maximum 3-hour concentration not to be exceeded more than once per year |
| Ozone (Old)[c] | 0.12 ppm maximum 1-hour concentration with an expected exceedance of no more than one day per year based upon a 3-year average. | Same as primary standard |
| Ozone (New) | 0.08 ppm based on the average of the fourth-highest daily maximum 8-hr concentration during each ozone season (currently May 1 – September 30) for each of three consecutive years. | Same as primary standard |
| Nitrogen Dioxide | 0.053 ppm (100 μg/m$^3$) annual arithmetic mean. | Same as primary standard |
| Carbon Monoxide | 35 ppm (40 milligrams per cubic meter [mg/m$^3$]) maximum 1-hour concentration not to be exceeded more than once per year.<br>9 ppm (10 mg/m$^3$) maximum 8-hour average concentration not to be exceeded more than once per year. | None. |
| $PM_{2.5}$ (New Standard) | 15 μg/m$^3$ annual average | 65 μg/m$^3$ (24-hour average) |
| $PM_{10}$ | 150 μg/m$^3$ maximum 24-hour average concentration with an expected exceedance of no more than one per year based upon a 3-year average.<br>50 μg/m$^3$ annual arithmetic mean. | Same as primary standard |
| Lead | 1.5 μg/m$^3$ maximum quarterly arithmetic mean. | Same as primary standard |

Source: 40 Code of Federal Regulations Part 50, as currently amended.
a - Standards set to protect public health.
b - Standards set to protect public welfare.
c - Only applicable in areas not attaining the standard prior to September 16, 1997.

National standards, other than annual standards, are not to be exceeded more than once per year (except where noted). Units are parts per million (ppm) by volume of air except for particulate matter and lead which are expressed in micrograms per cubic meter (μg/m$^3$). Attainment status for the new $PM_{2.5}$ standard for any site has yet to be determined. The original timeline for this new standard required monitors to be in place nationwide, between 1998 and 2000, with data collection taking place between 1998 and 2003. Assessment of attainment status for this new standard will only be possible after 3 years of data have been collected. The results of ambient air monitoring near PAF are shown in Table 3-2.

Table 3-2 gives the results of ambient air quality monitoring of criteria pollutants that are considered representative of the PAF site. All areas in the vicinity of the site are currently in attainment for $PM_{10}$, $NO_2$, CO, $SO_2$, Pb, and the one-hour $O_3$ standards.

**Table 3-2. Ambient Concentrations of Criteria Air Pollutants Compared With Air Quality Standards**

| Pollutant | Level of Standard (ppm)[a] | One-Year Maximum or Mean | |
|---|---|---|---|
| | | **Concentration (ppm)[a]** | **Percent of Standard** |
| Ozone (Old Standard)[b] | Maximum 1-hour average (0.12) | 0.108[d] | 90 |
| Ozone (New Standard)[c] | 4th Highest 8-hour average (0.08) | 0.101[d] | 126 |
| Sulfur Dioxide | Maximum 3-hour average (0.5) | 0.094[d] | 19 |
| | Maximum 24-hour average (0.14) | 0.023[d] | 16 |
| | Annual mean (0.030) | 0.0026[d] | 9 |
| Nitrogen Dioxide | Annual mean (0.053) | 0.0042[d] | 8 |
| Carbon Monoxide | Maximum 1-hour average (35) | 2.1[e] | 6 |
| | Maximum 8-hour average (9) | 0.9[e] | 10 |
| $PM_{10}$ (Old Standard) | (µg/m$^3$) | (µg/m$^3$) | |
| | Maximum 24-hour average (150) | 44.0[f] | 29 |
| | Annual mean (50) | 20.7[f] | 41 |
| $PM_{2.5}$ (New Standard) | Maximum 24-hour average (65) | 37.7[g] | 58 |
| | Annual average (15) | 16.4[g] | 109 |
| Lead | (µg/m$^3$) | (µg/m$^3$) | |
| | Quarterly mean (1.5) | Unavailable[h] | |

a - ppm unless otherwise noted.
b - Concentration must be 0.125 ppm or higher to be considered above the level of the standard (0.120).
c - Fourth-highest concentration must be 0.085 ppm to be considered above the level of the standard (0.08 ppm).
d - Ozone 1 hour, ozone 8 hour, $SO_2$, and $NO_2$ values for Muhlenberg County, Kentucky, 2001.
e - CO values for Daviess County, Kentucky, 2001.
f - $PM_{10}$ values for Hardin County, Kentucky, 2001.
g - $PM_{2.5}$ values for Hardin County, Kentucky, 2001.
h - Concentrations of lead have declined to levels that are so low that monitoring for lead is not routinely performed. Thus, representative measured concentrations are not available.

### *3.1.2. Environmental Consequences*

Air quality impacts can potentially occur during construction and operation of the proposed FGD systems. The following sections describe these impacts.

*Construction Impacts: Vehicle Emissions and Excavation Dust* - The proposal under consideration would have associated transient air pollutant emissions during the construction phase of the project. Construction-related air quality impacts are primarily related to land clearing, site preparation, and the operation of internal combustion engines.

Land clearing, site preparation, and vehicular traffic over unpaved roads and the construction site result in the emission of fugitive dust PM during site preparation and active construction periods. The largest fraction (greater than 95 percent by weight) of fugitive dust emissions would be deposited within the construction site boundaries. The remaining fraction of the dust would be subject to transport beyond the property boundary. If necessary, emissions from open construction areas and unpaved roads could be mitigated by spraying water on the roadways as needed to reduce fugitive dust emissions by as much as 50 percent. The project would comply with Kentucky regulations applicable to fugitive emissions.

Combustion of gasoline and diesel fuels by internal combustion engines (vehicles, generators, construction equipment, etc.) would generate local emissions of PM, $NO_x$, CO, volatile organic compounds, and $SO_2$ during the site preparation and construction period. The total amount of these emissions would be small and would result in minimal off-site impacts.

Air quality impacts from construction activities would be temporary and dependent on both man-made factors (e.g., intensity of activity, control measures, etc.) and natural factors (e.g., wind speed, wind direction, soil moisture, etc.). However, even under unusually adverse conditions, these emissions would have, at most, a minor, transient impact on off-site air quality and be well below the applicable ambient air quality standard. Overall, the air quality impact of construction-related activities for the project would not be significant.

*Operational Impacts* - Impacts due to the operation of the PAF Unit 3 FGD are expected to occur both near the facility and regionally. The primary near-facility impacts of concern are due to emissions of $SO_2$, PM, and $NO_x$. $SO_2$ emissions from Unit 3 would be reduced by the installation of FGD, but emissions of PM and $NO_x$ are not expected to change. Dispersion modeling was performed for the pre- and post-FGD case to quantify these impacts.

The installation of the FGD would be accompanied by a switch to a coal with higher-sulfur content than that currently being burned. One potential consequence is that emissions of sulfuric acid ($H_2SO_4$) mist may increase. This possibility is increased by the presence of SCR, which enhances the chemical reactions that can ultimately lead to an increase in $H_2SO_4$ emissions. Because of the optical properties of $H_2SO_4$, this could lead to a visible plume. This is not expected to be significant. Even with the potential for the higher $H_2SO_4$ emissions, opacities during normal operations will be maintained below the 20 percent regulatory limit.

An air quality analysis was performed in accordance with USEPA's Guidelines on Air Quality Models. The focus of the analysis was to determine the air quality impacts of each pollutant on the area surrounding the proposed facility.

Refined modeling was performed using the USEPA-approved ISCST3, model, assuming maximum (i.e., worst-case) emissions. These modeling runs were made using detailed receptor sets and representative hourly meteorology. A description of the dispersion models, data requirements, and modeling results are presented in the following sections.

The stack physical dimensions, flue gas parameters, and emission rates used in the modeling are presented in Tables 3-3 and 3-4. The emission rates used for the modeling assumed continuous operation during the year. The emissions and exhaust flows presented in the tables are based on maximum operating conditions. This approach ensured that the modeling produced estimates of worst-case ambient impacts.

**Table 3-3. Stack Locations and Physical Dimensions**

| No. | Easting (km) | Northing (km) | Stack Base Elevation (ft-msl) | Stack Height (m) | Stack Diameter (m) | Stack Exit Velocity (m/s) | Stack Temperature (K) |
|---|---|---|---|---|---|---|---|
| 1 | 501.910 | 4123.610 | 422 | 182.9 | 7.9 | 22.1 | 325 |
| 2 | 501.870 | 4123.560 | 422 | 182.9 | 7.9 | 22.1 | 325 |
| 3 (Post-FGD) | 501.758 | 4123.502 | 422 | 128.0 | 11.9 | 15.2 | 328.6 |
| 3 (Pre-FGD) | 501.758 | 4123.502 | 422 | 243.8 | 8.2 | 34.5 | 414 |
| 3 (Bypass FGD) | 501.758 | 4123.502 | 422 | 243.8 | 8.2 | 34.5 | 414 |

km – kilometer
ft-msl – feet mean sea level
m – meter
m/s – meter per second
K – Kelvin

**Table 3-4. Worst-Case Emissions**

| Unit | Pollutant | Emission Rate (g/s) |
|---|---|---|
| 1 | $SO_2$ | 1052 |
| | $NO_x$ | 132 |
| | $PM_{10}$ | 96 |
| 2 | $SO_2$ | 1052 |
| | $NO_x$ | 132 |
| | $PM_{10}$ | 96 |
| 3 (Post-FGD) | $SO_2$ | 361 |
| | $NO_x$ | 217 |
| | $PM_{10}$ | 159 |
| 3 (Pre-FGD) | $SO_2$ | 7104 |
| | $NO_x$ | 217 |
| | $PM_{10}$ | 159 |
| 3 (Bypass FGD) | $SO_2$ | 7893 |
| | $NO_x$ | 217 |
| | $PM_{10}$ | 159 |

The ISCST3 model was used to estimate air pollutant concentrations surrounding the plant. A description of ISCST3 is contained in Volume II of the user's guide. The model is based on the straight-line, steady-state Gaussian plume equation, which is used with some modifications to model simple point source emissions. The model was run for each of the operational cases applicable to a particular alternative. As a conservative measure, the worst-case modeled impact was used for all averaging periods.

The refined ISCST3 modeling was performed with receptors extracted from the USGS digital elevation model database. The receptors covered a 20-kilometer (km) by 20-km area centered on the site. Receptor spacing varied with distance from the site, with those nearest the site more closely spaced. Receptors within 1.5 km from the site were spaced 100 meters (m) apart, those between 1.5 and 5 km from the site were spaced 250 m apart, and those beyond 5 kilometers were spaced 500 m apart.

ISCST3 dispersion modeling was performed using 5 years (1995, 1997-2000) of meteorological data based on hourly National Weather Service surface observations from Evansville, Indiana, and twice-daily upper air measurements from Nashville, Tennessee. Hourly mixing heights were determined from Nashville, Tennessee, morning and afternoon mixing depths.

Dispersion modeling was performed to evaluate the potential change in impact of the project on air quality. The modeling results also provide a comparison of impacts relative to the NAAQS.

Table 3-5 shows a summary of the dispersion modeling results for the worst-case operating scenario for the pre- and post-FGD case. The maximum concentration (in micrograms per cubic meter) in the vicinity of the plant site is presented for each averaging period applicable to $SO_2$. None of the maximum concentrations exceed the applicable NAAQS.

The results indicate a reduction in worst-case local $SO_2$ impacts and a slight increase in local impacts of other pollutants because of installation of FGD on Unit 3. (The reason for the relatively small change in local impacts between the pre- and post-FGD case is because emissions—and consequent ambient impacts—from Units 1 and 2 remain unchanged.) The post-FGD increase in $PM_{10}$ and $NO_2$ occurs because of the use of a shorter stack for post-FGD operation. $SO_2$ impacts, however, are less in the post-FGD case because the reduction in $SO_2$ emissions more than offsets any increase due to the use of a shorter stack. The results also show a slight increase in local $SO_2$ impacts for the post-FGD bypass case. This increase is due to an increase in $SO_2$ emissions from Unit 3 due to the planned use of coal with higher sulfur content than that which is currently used. The impact to overall air quality is a net benefit due to reduction in $SO_2$ emissions.

*Cumulative Regional Impacts* - The installation of FGD at PAF Unit 3 is part of an $SO_2$ emissions reduction effort that contemplates FGD installation on several of TVA's fossil plants. The other units being considered for installation of FGD are COF Unit 5, BRF Unit 1, and KIF Units 1-9. The proposed action (installation of FGD on PAF Unit 3) is part of a TVA system-wide emissions reduction effort that is expected to benefit overall regional air quality.

**Table 3-5. Summary of Estimated Local Impacts on Air Quality**

| Pollutant | Averaging Period | NAAQS (µg/m³) | Estimated Concentration[a] (µg/m³) Pre-FGD | Post-FGD | Post-FGD Bypass |
|---|---|---|---|---|---|
| $SO_2$ | Annual | 80 | 12.05 | 8.58 | 12.59 |
| | 24-hour | 365 | 182 | 139 | 188 |
| | 3-hour | 1300 | 902 | 774 | 969 |
| $PM_{10}$ | Annual | 150 | 0.77 | 1.26 | 0.77 |
| | 24-hour | 50 | 11.83 | 18.12 | 11.83 |
| $NO_2$ | Annual | 100 | 1.05 | 1.73 | 1.05 |

a. Estimated concentration is the maximum annual and highest; second-highest for shorter average periods.

Cumulative impacts on air quality in the Southeast due to changes in future emissions were evaluated by the Southern Appalachian Mountains Initiative (SAMI) by performing extensive photochemical and regional haze modeling. A primary conclusion from SAMI's work was that reduction of emissions within a state would provide the most improvement to the air quality within the same or adjacent states. Although SAMI did not model individual sources, the conclusions of the study can be extended to a collection of sources to infer that the primary air quality benefit of $SO_2$ emissions reductions will be within the states where they are located and in the region adjacent to those states. Thus, although $SO_2$ emissions reductions due to installation of FGD at BRF, COF, KIF, and PAF are expected to lead to improvement in overall regional air quality, the most improvement would be within the TVA region.

## 3.2. Vegetation, Wildlife, and Natural Areas

### *3.2.1. Affected Environment*

*Vegetation* - PAF is located in Muhlenberg County, Kentucky, in the Interior Low Plateaus physiographic province (Fenneman, 1938). Botanically, it occurs in the Shawnee Hills section of the Western Mixed Mesophytic Forest Region as described by Braun (1950). Native forests in the area were generally dominated by various species of oak (particularly white oak) and hickory, but these forests have been extensively modified since the time of human settlement. Throughout the region, areas of remaining old growth as well as secondary forests vary in composition in relation to topography and soil moisture conditions. These forests include representatives of oak-hickory, beech-dominated, and mixed mesophytic communities (Bryant et al., 1993).

The proposed project would result in a 95 percent reduction in $SO_2$ emissions from PAF Unit 3 at full load conditions. Sulfur emissions contribute to acid deposition, which has been implicated in the decline in forest health in the United States. Although this trend has been well documented in the high elevation spruce-fir forests of the northeastern states and the southern Appalachians, the majority of forest ecosystems in the eastern United States are not currently known to be significantly affected by sulfur (or nitrogen) deposition (NAPAP, 1998; USDA Forest Service, 2001). However, these less sensitive forests are exhibiting gradual losses of soil nutrients due to acid deposition, which has the potential to reduce forest health over the long term (NAPAP, 1998).

*Wildlife* - Much of the areas within PAF have been heavily impacted and altered as a result of past strip mining, construction, and operation of the existing facility. Some areas toward the periphery of the fossil plant are less disturbed or have recovered through mine reclamation activities. The southern section of PAF is contiguous with Peabody State Wildlife Management Area (WMA), which provides habitat for numerous animal species. Some animals may find suitable habitat and foraging opportunities within small patches of forest and aquatic areas within PAF. Ash ponds associated with the fossil plant provide foraging habitat for a variety of shorebirds. Areas directly affected by the proposed scrubber system and associated activities, however, are heavily disturbed and consequently offer very limited wildlife habitat.

*Natural Areas* - All project activities related to the construction and operation of a scrubber system on Unit 3 would take place within the formal boundaries of PAF. PAF is located between the Sinclair and Ken Hopewell tracts of the Peabody WMA. The Sinclair tract is adjacent to PAF along the plant's southern boundary from SR 176 east to Riverside Road. The Ken Hopewell tract is situated across the Green River from PAF, approximately one-half mile northeast of the plant. Peabody WMA is a rough terrain of reclaimed coal-mined land with numerous excavated ridges and water-filled strip mine pits. Waterfowl and small and big game frequent swamplands, high ridges, and deep pits. Fishing and hunting opportunities are excellent. Hunts are administered by the Kentucky Department of Fisheries and Wildlife Resources. Horseback riding is popular on trails within the Ken Hopewell tract. Primitive camping is allowed on all WMA land.

Both the Sinclair tract of the Peabody WMA and the PAF ash basin are well known birding locales. Bald eagle, golden eagle, osprey, and snow goose have been noted at Goose Lake, just southwest of PAF. Summertime brings Bell's vireo, willow flycatcher and Henslow's sparrow to the WMA. In the winter, shorebirds and a large raptor population, including northern harriers and short-eared owls, visit the area for its abundance of small mammals. The PAF ash basin is celebrated for its population of nesting bank swallows.

### *3.2.2. Environmental Consequences*

*Vegetation* – Under the No Action Alternative, $SO_2$ emissions from PAF Unit 3 would continue at current levels. Any impacts to the vegetation of the state and surrounding region resulting from acid deposition would continue to occur. However, no uncommon plant communities are known from the immediate vicinity of PAF, and no impacts to such communities are anticipated if the No Action Alternative is selected.

Selection of the Proposed Action Alternative would reduce $SO_2$ emissions from PAF Unit 3 by 95 percent at full load conditions. As stated above, acid deposition, caused in part by sulfur emissions, has been linked to the decline of some high elevation forest communities (NAPAP, 1998). Therefore, reductions in sulfur emissions would be expected to benefit directly these communities. However, the majority of communities in the surrounding vicinity of PAF are not currently known to be substantially threatened by acid deposition (NAPAP, 1998; USDA Forest Service, 2001). Therefore, the proposed project would not be expected to result in measurable benefits to these forests. Although the local benefits associated with the current proposed project are not expected to be significant, the combined results of this and similar proposals throughout the TVA Power Service Area could collectively benefit the high elevation forest ecosystems of the region. Because no uncommon plant communities are known from the immediate vicinity of PAF, no adverse impacts to such communities are expected as a result of the Proposed Action Alternative. Overall, the proposed project is not expected to result in significant, adverse impacts to the terrestrial ecology of the state or region.

The proposed project activities would occur entirely within the PAF reservation boundary. Nearly all activities (with the exception of limestone delivery routes) including utility routes would be confined to areas previously disturbed during either the construction or operation of the existing fossil plant facilities. Typically, little to no vegetation (native or otherwise) remains on the site. Although some forests are present toward the southern and southwestern periphery of the PAF reservation boundary, these local areas would not be affected by the current project proposal.

*Wildlife* – Under the No Action Alternative, any indirect or cumulative impacts to terrestrial animals would persist as a result of the current levels of $SO_2$ emissions. Direct impacts to terrestrial species would be insignificant.

Because the proposed actions are confined to heavily disturbed areas of the fossil plant, direct, indirect, and cumulative impacts to terrestrial animals would be insignificant. Due to improvements in air quality, completion of the project may result in minor beneficial effects to terrestrial animals at the local and regional level.

The proposed FGD system installation and associated activities do not impact habitat suitable for wildlife, and therefore are not expected to affect migratory bird populations or unique animal habitat. Similarly, the proposed construction would not result in the spread of exotic or invasive terrestrial animals.

*Natural Areas* – Under the No Action Alternative, the scrubber system would not be installed on Unit 3, and no impacts would occur to the Peabody WMA as a result of any construction and operation activities. However, present levels of $SO_2$ emissions would continue to affect the quality of habitat and visitor experience in the WMA.

Under the Action Alternative, a scrubber system would be installed on Unit 3 of PAF. Although the Sinclair tract of the Peabody WMA is located directly adjacent to the plant, all construction work would occur within plant boundaries, and no impacts are anticipated as a result of activities related to installing the scrubber system. The PAF ash ponds are popular with local birders, but this area is located on the perimeter of the plant, at an ample distance (over one-half mile) from construction activities. Operation of the scrubber system would not directly affect surrounding areas, but would reduce $SO_2$ emissions, resulting in possible benefits for visitors and wildlife within the WMA.

## 3.3. Protected and Sensitive Species

### *3.3.1. Affected Environment*

*Plants* – Review of the TVA Regional Natural Heritage and the Kentucky Natural Heritage databases revealed that no federal- or state-listed plant species have been reported from within 5 miles of PAF. Additionally, no federally listed plant species have been reported from the surrounding vicinity of PAF in Muhlenberg or Ohio Counties, Kentucky.

Because of the extent of prior disturbance within the proposed project area, no occurrences of rare plant species are anticipated within the areas to be affected by the proposed project.

*Terrestrial Animals* – A review of the Natural Heritage Database indicated that five state-listed species have been reported within a 3-mile radius of the fossil plant (Table 3-6). No federal-protected species have been reported from Muhlenberg or Ohio Counties, Kentucky.

**Table 3-6. Rare Terrestrial Animals Reported From Areas Within a 3-Mile Radius of Paradise Fossil Plant**

| Common Name | Scientific Name | State Status | Federal Status |
|---|---|---|---|
| Bank Swallow | *Riparia riparia* | Special Concern | — |
| Bell's Vireo | *Vireo bellii* | Special Concern | — |
| Common Moorhen | *Gallinula chloropus* | Threatened | — |
| Great Blue Heron | *Ardea herodias* | Special Concern | — |
| Northern Harrier | *Circus cyaneus* | Threatened | — |

For most of the species listed above, areas within PAF do not meet the habitat requirements. Bell's vireos often nest in thickets near water, but may also nest among vegetation in any successional stage with a dense understory. Common moorhens generally nest in marsh plants over water, primarily in areas of emergent vegetation and grassy borders. Aquatic areas within PAF are unlikely to provide sufficient vegetative habitat for these species. Great blue herons typically forage in shallow water and their colonial nests are commonly located near rivers and reservoirs. These large wading birds forage in the ash disposal ponds on site. A heron colony has been reported southeast of the fossil plant along the Green River, but there are no colonies within PAF. Northern harriers forage in open habitats, often near cattail marshes, shrub uplands, or wet meadows. This species is not expected to nest within the project site.

Bank swallows generally nest in steep sand, dirt, or gravel banks and pits in open or partly open habitats. They often dig a new burrow each year, but tend to return to the same nesting area in successive years. Approximately 150 nest burrows of this species have been reported in a coal refuse pile in the southeast portion of PAF. This nesting colony was first reported in 1998 and is presently in the same area, just south of Reed Minerals processing area. These birds actively forage over the ash ponds and other wetlands on site.

*Aquatic Animals* – A search of the TVA Regional Heritage Project database, and data from the Kentucky State Nature Preserves Commission, indicated that seven aquatic animal species with either federal or state status are historically known from the Green River in the vicinity of PAF (Table 3-7). Only one of these, the fanshell, is federal-protected.

All of these species are potentially still present in the Green River near PAF. None of these species are likely to occur in ponds or small lakes on the PAF site.

**Table 3-7. Sensitive Aquatic Species Known From the Green River, Muhlenberg and Ohio Counties, Kentucky**

| Common Name | Scientific Name | Federal Status | Kentucky Status |
|---|---|---|---|
| **Mussels** | | | |
| Fanshell | *Cyprogenia stegaria* | Endangered | Endangered |
| Pyramid pigtoe | *Pleurobema rubrum* | - | Endangered |
| Purple lilliput | *Toxolasma lividus* | - | Endangered |
| Little spectaclecase | *Villosa lienosa* | - | Special Concern |
| **Fish** | | | |
| Longhead darter | *Percina macrocephala* | - | Threatened |
| Chestnut lamprey | *Ichthyomyzon castaneus* | - | Special Concern |
| Eastern sand darter | *Ammocrypta pellucida* | - | Special Concern |

### *3.3.2. Environmental Consequences*

*Plants* – No occurrences of rare plant species are anticipated within the areas that would be affected by the proposed project. No impacts to such resources would occur as a result of the No Action or Proposed Action Alternatives.

*Terrestrial Animals* – Under the No Action Alternative, any indirect or cumulative impacts to protected terrestrial animals would persist as a result of the continuous production of $SO_2$. Direct impacts to these species would be insignificant.

For the Proposed Action Alternative, no suitable habitat for rare terrestrial animals is present on the areas proposed for construction. The large nesting colony of bank swallows occurs near the perimeter of the fossil plant, well beyond any of the areas associated with the proposed activities. The project is not expected to result in adverse impacts to these and other sensitive resources in the region. Due to improvements in air quality, completion of the project may result in minor beneficial effects to protected terrestrial animal species at the local and regional level.

*Aquatic Animals* – If the No Action Alternative were adopted, there would be no construction and no impacts to protected aquatic species. Construction of the proposed FGD system would not result in any significant changes to water quality in the Green River with the implementation of standard BMPs during construction of the facility. Operational discharges from cooling systems and settling ponds associated with this facility would likely have little or no effect on water quality in the Green River. Therefore, this action would likely have no direct impacts on sensitive or federal- or state-protected aquatic animals and no adverse effect on the habitats of endangered, threatened, or other protected species occurring in the Green River.

## 3.4. Wetlands and Floodplains

### *3.4.1. Affected Environment*

*Wetlands* – Some small areas of forested, scrub-shrub, and emergent wetlands occur in the general vicinity of PAF. These small wetland areas are associated with the Green River, Jacobs Creek, Peabody Lake, and the Tadpole Pond (Robinson, 1995). Various species of resident and migratory waterfowl, wading birds, shorebirds, and marsh birds use these habitats regularly during various seasons of the year. Other than the occasional marsh bird, most of these are common and widespread in their distribution.

There are numerous ponds at PAF for water treatment that may in part be wetlands. These ponds include coal yard drainage basins, fly ash ponds, metal cleaning waste ponds, coal wash refuse fines ponds, FGD gypsum byproduct rim ditch stack runoff pond, and others. However, because these wetlands are a part of the plant wastewater treatment system, none of these treatment units are classified as jurisdictional wetlands falling under the Clean Water Act. There are no jurisdictional or non-jurisdictional wetlands at the proposed locations of the FGD system components.

*Floodplains* – PAF is located at Green River mile 100.2 in Muhlenberg County, Kentucky. Information provided by the USACE indicates that the 100-year floodplain at this location would be the area located below elevation 401.0. The 500-year, or “critical action floodplain,” would be the area below elevation 403.7. A “critical action” is defined in the Water Resource Council Floodplain Management Guidelines as any activity for which even a slight chance of flooding would be too great.

### *3.4.2. Environmental Consequences*

*Wetlands* – There are no jurisdictional or non-jurisdictional wetlands at the proposed locations of the scrubber components, ancillary support equipment, or areas of on-site rail refurbishment. No wetlands would be disturbed by trenching for conduits or piping. Further, no operational impacts to wetlands would occur. Thus the terms of Executive Order (EO) 11990 (Protection of Wetlands) would be satisfied.

*Floodplains* – Under the No Action Alternative, the floodplain areas would not be impacted, and there would be no change in existing conditions.

For the proposed project, construction of the scrubber system along with the support facilities, such as the substation, switchyard, and overhead power lines, would not involve siting within the 100-year floodplain, which would comply with EO 11988. The facilities for which even a slight chance of flooding would be too great (scrubber system, etc.) would be located well above the 500-year flood elevation.

The proposed limestone handling area, laydown areas, overhead power lines, and gypsum sluice pipeline would not be located within the 100-year floodplain. Improvements to the existing on-site rail delivery system would not involve construction within the 100-year floodplain. The existing gypsum storage ponds are not located within the 100-year floodplain. The proposed water supply improvements would involve construction of underground water lines, a portion of which could be located within the 100-year floodplain. For compliance with EO 11988, an underground water line is considered a repetitive action in the floodplain that should result in minor floodplain impacts because the area would be returned to preconstruction conditions after completion of the project. If new pumps and/or electrical equipment are installed in the existing intake structure, they would be elevated above or flood proofed to the 500-year flood elevation 403.7.

## 3.5. Land Use, Visual Aesthetics, and Noise

### *3.5.1. Affected Environment*

*Land Use and Visual Aesthetics* – The plant site is surrounded by partially wooded, gently rolling hills, open meadows, various ponds, and no nearby homes. Most of the land and ponds are former strip mines that have been reclaimed. The Green River borders the plant on the northeast, with wooded shoreline and agricultural land on the opposite bank. The large-scale industrial facilities of the plant provide a significant visual contrast to the surrounding rural landscape. The most dominant visual features include two 600-foot-high and one 800-foot-high stacks, transmission line towers, and three cooling towers over 435 feet high. They can be seen above the hills for several miles. Other principal features include the large powerhouse and related structures, coal handling facilities, rail yards, and switchyard, along with various ash and waste disposal areas.

Existing scrubbers are prominent features located on the west side of the powerhouse. Scrubber gypsum byproduct conveyors run along the north and east sides, and then continue southwest to the disposal areas. Limestone receiving and processing facilities are located south of the cooling towers and east of the main entry gate.

Most plant features can be seen by motorists on SR 176, which ends at the entry gate, and those on the county road that bisects the site. The county road runs north from SR 176 near the coal wash facility and south from the rail unloading point, running between the plant and disposal areas. Plant features are also visible from boat traffic on the Green River and bordering agricultural land.

Proposed routes for limestone delivery by rail would use current railroad lines. The route from Martin Marietta Quarry runs to a point near the Rogers Group Quarry, where it becomes common to both and continues on to the plant. The routes generally run through sparsely populated countryside and small communities, occasionally paralleling and crossing rural state highways. Several federal highways are crossed as well. The lines also pass through more urban areas of Princeton, Madisonville, and Central City, as well as skirting the edge of Dawson Springs. The routes are seen from a variety of public viewing points and viewing distances along the way.

Proposed truck routes for limestone delivery run south from the Martin Marietta Quarry to the Parkway, and north from the Rogers Group Quarry to the Parkway at Princeton. The Fredonia route is primarily a rural, two-lane highway that runs through sparsely populated agricultural countryside. The residential density is somewhat greater at Fairview, about a mile from the Parkway. The route from Rogers Group Quarry begins as a rural, two-lane highway, and passes through an area of rural homes, large trees, and lawns. Within 1½ miles, it becomes a residential street, running through an attractive neighborhood of older established homes in Princeton. This route has much greater public visibility than the Fredonia route. It also goes through the downtown area and other residential areas before entering the Parkway. From there, the route is common to both alternatives and continues east on the Parkway toward the plant. It passes through a sparsely populated pastoral countryside, much of which is reclaimed strip-mined land. Views of the Parkway are limited by the predominately wooded right-of-way. The route leaves the Parkway and follows SR 70 south through similar countryside to Drakesboro, then SR 176 east to the plant. There are relatively few homes located along this portion. Considerable truck traffic is seen on this part of the route, as well as on the Parkway.

*Noise* – In order to predict the effects of constructing and operating the Unit 3 FGD system, it is important to document noise levels in the vicinity of existing operations. Unit 3 is adjacent to other operating units at PAF, which is located in a rural area approximately 5 miles northeast of Drakesboro, Kentucky, the nearest populated area. There are no sensitive noise receptors within 2 miles of the plant (i.e., residences, hospitals, businesses, etc.). Existing power plant noise levels were measured at several different locations on and around the reservation by a Quest Model 2900 Integrating Sound Level Meter. Noise monitoring locations are identified on Figure 3-1. Noise data are most commonly expressed in decibels (dB), and the A-weighted decibel scale (dBA) is used since this scale most accurately represents the response of the human ear to a noise stimulus.

Data were collected by operating the integrating feature of the noise monitor for relatively short runs of several minutes until an "average" noise level stabilized. Monitoring locations were chosen to be representative of operating and/or background noise levels for the selected areas. Measurements were conducted on August 22, 2002, at eight locations, while the plant was operating at full load. The rated capacity of Units 1 and 2 is 704 MW each and Unit 3's rated capacity is about 1,056 MW. Two of the three available ball mills were operating (35 tons per hour each) and coal, limestone, and ash trucks were operating with a normal schedule. Winds were calm, and traffic on the roads outside the plant area was light. Traffic on the haul roads and near the ball mill was heavy with coal, limestone, and ash removal truck traffic.

No homes were observed within a 2-mile radius of the center of the plant. The closest residential or commercial structure is an unoccupied metal farm building located on Riverside Drive (Location 8) approximately 2.0 miles south of the plant. The cooling tower plumes from the plant are visible from this location, but because of rolling terrain between this point and the plant, the cooling towers, the stacks and the other power plant structures are not visible. No power plant operating noise could be heard at this location.

Background noise level measurements were also made at the intersection of Riverside Road and Riverside Church Road (Location 7), which is approximately 1.7 miles southeast of the plant. The plant's cooling towers and stacks are visible from this location. No plant operating noise could be heard at this location.

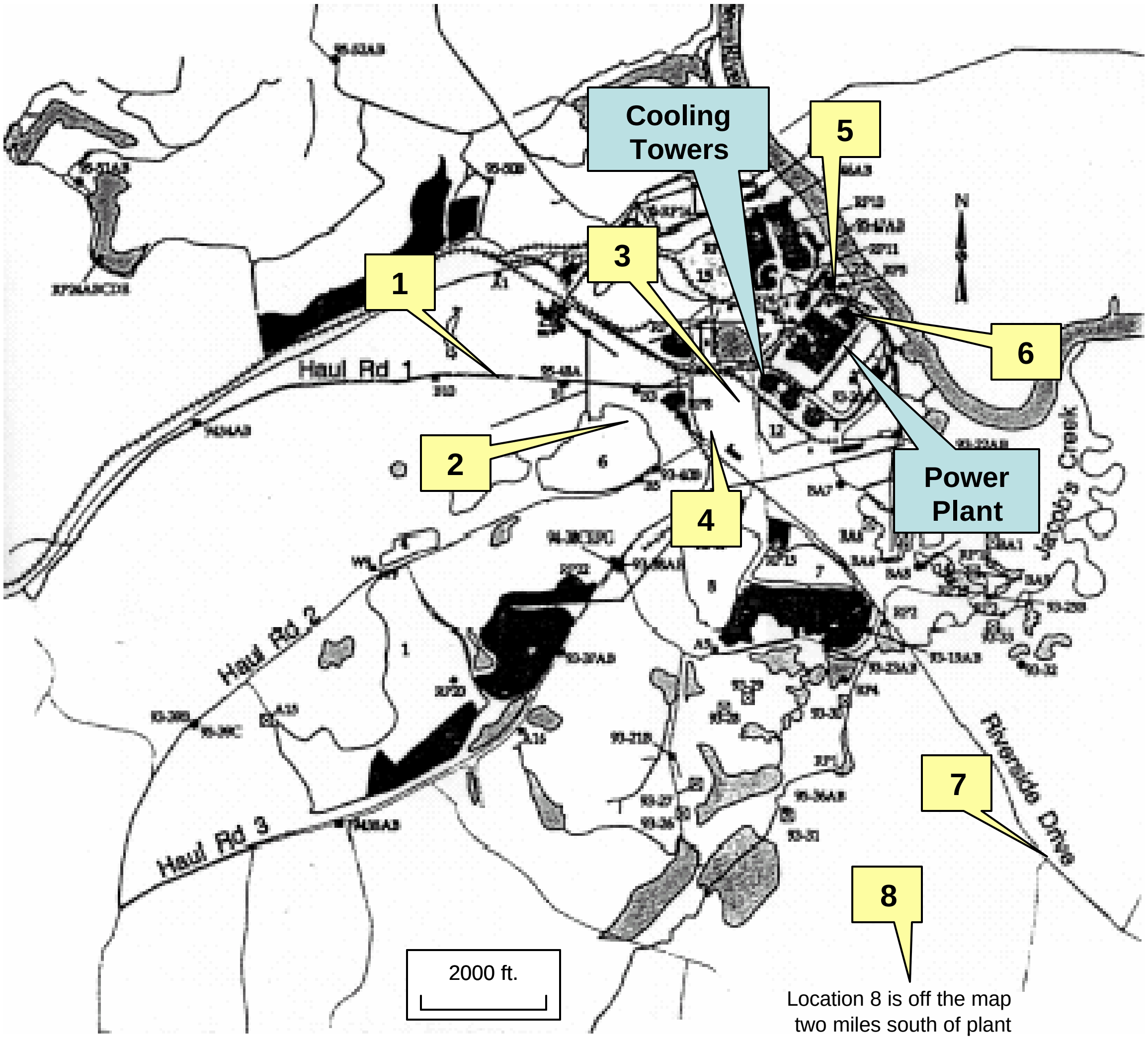



**Figure 3-1. Noise Monitoring Locations**

Additional noise measurements were made at several areas near the plant. Location 2 was a point overlooking the plant from a closed ash disposal area (Dry Ash Area 1), approximately one-fourth mile to the west. Noise from the plant was easily heard at this location. This location provided an excellent measure of "whole plant" noise since the noise from individual sources is consolidated into a single point at this distance and is clearly higher than background noise.

Locations 3 and 4 were 100 feet and 400 feet, respectively, southeast of the existing ball mill building. Locations 5 and 6 were on the northeast side of the plant near Unit 1. The noise data collected at location 5 reflected substantial noise from the vacuum filter building coming through an open metal "garage-type" roll-up door directly toward the monitoring point. Additional monitoring took place along Haul Road # 1 (Location 1) which experiences noise from trucks entering and exiting the plant.

The average noise levels at the two remote background sample locations sampled (Locations 7 and 8) are typical of a rural area with little traffic. Noise measurements taken in these areas are described in Table 3-8. Average background noise levels in the area were 40.3 to 40.4 dBA, respectively. The noise detected at these locations was exclusively from natural causes, such as the sounds of birds and insects and from wind moving through nearby leaves. According to Beranek and Ver (1992), noise in quiet, urban, residential areas, which would be similar to a rural residential area, ranges from 40 to 50 dBA during the day and 35 to 45 dBA during the night.

**Table 3-8. Remote Noise Monitoring Results**

| Location | Average (dBA) |
|---|---|
| #7 – Intersection of Riverside Road and Riverside Church Road, about 1.7 miles southeast of the plant | 40.3 |
| #8 – At metal farm building about 2.6 road miles and about 2 miles cross country from the plant | 40.4 |

As described above, noise monitoring was also conducted at selected locations near the plant, at distances of 100, 200, and 400 feet from major operating systems of interest. The results of those studies, listed below in Table 3-9, reflect the relative influence of various noise-producing equipment, such as pumps, fans, and materials handling associated with normal plant operations.

**Table 3-9. Plant Area Noise Monitoring Results**

| Location | Average (dBA) |
|---|---|
| #2 – Disposal area (Dry Ash Area 1) - located about one-fourth mile west of the plant | 44.5 |
| #3 – Ball Mill Area – 100 feet southeast of ball mill building | 66.9 |
| #4 – Ball Mill Area – 400 feet southeast of ball mill building | 59.2 |
| #5 – Unit 1 Area – 300 feet northeast of the Unit 1 scrubber (note – these data were heavily influenced by noise from the vacuum filter building) | 69.6 |
| #6 – Unit 1 Area – 207 feet northeast of the Unit 1 scrubber | 68.5 |

Measurements at Location 1, which is about 25 feet to the side of Haul Road No. 1, reflect the intermittent noise produced by coal and limestone trucks passing by. These measurements were necessarily of short duration, about 30 seconds each, to determine the noise associated with each truck-passing event. The noise monitor was set to integrate the noise signal, i.e., the instruments response, during the 30-second event. Table 3-10 presents the results of four truck-passing scenarios, and encompasses both uphill and downhill travel.

**Table 3-10. Haul Road No. 1 Noise Monitoring Results**

| Scenario | Average (dBA) |
|---|---|
| One truck proceeding downhill toward the plant, normally loaded | 68.3 |
| Two trucks proceeding uphill away from the plant, not normally loaded | 78.1 |
| One truck proceeding toward the plant and one truck proceeding away | 76.6 |

It is important to note that, except for the remote sampling locations 7 and 8, the public is not normally exposed to the noise levels indicated. There is no public thoroughfare that passes through the reservation, and many of the areas discussed above where measurements were made are off limits to the public for plant security and safety reasons. Many of these stations were chosen to assess impacts to TVA employees who work in and around the plant.

### *3.5.2. Environmental Consequences*

*Visual Aesthetics at Plant Site* – Proposed scrubber units, related facilities, and construction areas would all be located fully within the plant site and adjacent to existing facilities. The industrial land use would not change since these locations are used regularly for purposes associated with plant operations.

The proposed features would increase the number of moderately sized structures seen around the plant and could increase truck traffic on the access road. The new facilities would create little if any overall change in the visual character of this industrial plant site, so the impacts of these additions would be insignificant. The scrubber unit would include large duct and equipment structures along with a new stack and would be located on the west side of the powerhouse. It would extend from Unit 3 precipitators across the main road and part of the yard area and would require minor relocation of the road. New transformers and a connecting power line for the unit would be visible along the north side of the cooling towers. Alternative Route C for the elevated gypsum waste pipeline would be the shortest and would probably have the least public visibility since it only crosses the county road. Alternatives A and B would parallel the county road about one-fourth mile before crossing it, and A would be the longest route. New limestone receiving and processing features would be seen adjacent to the existing facilities. These various additions would all have about the same scale, color, and form as similar facilities existing nearby and would appear subordinate to the large-scale stacks and cooling towers. They would be seen primarily from the parking lots, main gate, and plant yard areas by visitors and employees. Most additions would also be visible to passing motorists on the county road south of the plant.

The visual discord of construction activities, materials, and equipment at the plant would be temporary and relatively minor. Some activities and the main laydown area would be seen by motorists on the county road. Alternative Laydown Area C would be the most visible, and Alternative B would be the next. Alternative A would be located among existing facilities east of the plant and would not be visible to the public.

*Visual Aesthetics Along Truck Delivery Routes* – If limestone were delivered only by truck, substantial congestion and visual discord would be seen on the plant access road (SR 176) from U.S. Highway 431. Employees and other motorists normally using that road would see at least twice as many large trucks, potentially increasing from about 60 round trips per day up to 130 per day. A 25-ton truck would be encountered about once every 2 minutes or less based on a single 8-hour day shift. The additional trucks would have equal or greater impacts for motorists on U.S. Highway 431, which is also used by logging and coal trucks.

The added truck traffic would have moderately low adverse impacts along the route from the Martin Marietta Quarry to the Parkway. The widely scattered homes and farms have deep front yards along this very rural route, and the traffic is light. The only highway intersection is at Fairview. Although the discordant truck volume would be the same, a relatively small population would be adversely affected. The negative impacts would increase proportionally with residential growth.

The route from the Rogers Group Quarry passes through the town of Princeton. The large size and frequent presence of the trucks would add visual discord and congestion to the relatively narrow streets. They would be seen in the immediate foreground from porches and from shallow front yards and sidewalks, as well as by local motorists. Scenic integrity and tranquility of the neighborhoods would be reduced, which would reduce the aesthetic character and sense of place. As the RFPs for supplying limestone will likely not be released and competitively bid until 2005-2006, the source of limestone cannot be determined for the PAF Unit 3 scrubber until that time. Except as discussed for Cultural Resources, no additional mitigation is needed or proposed for any of the delivery routes.

*Visual Aesthetics Along Rail Delivery Routes* – If limestone were delivered only by rail, any visual impact at the plant would be minimal. Once a week, delivery by a one-unit train would result in little if any visual discord, since coal trains have been a common sight in the area for years. Another train would likely not be noticed by employees or the public except at county road crossings. No additional visual impacts are anticipated as a result of the unit train hauling limestone along the routes from either quarry.

*Noise* – Noise is considered “unwanted sound” because it has the potential to interfere with normal activities and can cause physical or psychological damage to humans at elevated exposure levels. Humans are exposed to noise at work, leisure, travel, and home; however, it is desirable that humans are not continually exposed to an excessive amount of noise throughout the day, evening, and night. Community noise, or any noise that would affect a person in a home, school, business, place of worship, etc., is measured by the amount of noise that is produced during different times in the day.

Normal conversation ranges from 60 to 75 dB at 3 feet, while a jet engine taking off measures around 115 dB at 500 feet. Two different tones of noise produced at the same level (i.e., a low-pitched hum of a heating unit and a high-pitched sound of a telephone ringing) do not sound the same to the human ear. Most people do not hear low-pitched sound as well as high-pitched sound; therefore, noise is measured in the “A-weighted” sound level scale, referred to as dBA. This measuring system is the weighting scale that most closely approximates the perception by the human ear. Table 3-11 below lists some examples of common noise sources and their relative noise levels in dBA.

**Table 3-11. Typical Noise Source Levels**

| Sound | Noise Level (dBA) |
|---|---|
| Noise at ear level from rustling leaves | 20 |
| Soft whisper at 5 feet | 34 |
| Room with window air conditioner | 55 |
| Conversational speech | 60 to 75 |
| Passenger car at 50 feet | 69 |
| Ringing alarm clock at 2 feet | 80 |
| Motorcycle at 50 feet | 82 to 85 |
| Heavy city traffic | 90 |
| Home lawn mower | 98 |
| Jet aircraft at 500 feet overhead | 115 |
| Human pain threshold | 120 |

Source: Hirschorn, 1989

Community noise impacts are usually evaluated with respect to existing background sound levels and the increase that the facility noise would impose on this background level of noise. There are no federal or state noise statutes for the communities surrounding this site. The USEPA has recommended a system for considering the impacts of noise in both indoor and outdoor spaces, which was developed with the intention of protecting public health and welfare over life spans (USEPA, 1973). The “outdoor activity interference” level is 55 dBA, commonly measured at the property line of the recipient of the noise. This level (regarded by the USEPA to be a long-term goal, not a standard) is an annual Day-Night Average Sound Level ($L_{dn}$) for a 24-hour period and includes a 10-dBA penalty added to intruding noise between 10:00 p.m. and 7 a.m. According to USEPA, the noise attenuation from typical residential construction would reduce the 55 dBA $L_{dn}$ by 15 to 25 dBA for opened and closed windows, respectively, to provide an acceptable indoor noise environment.

There are no residences or potential noise receptors located within 2 miles of the plant in any direction. Similarly, there are no residences located along SR 176 which connects the plant to U.S. Highway 431 at Drakesboro about 5 miles to the southwest.

*Noise - Construction Impacts* – Construction activities associated with the proposed project would last about 21 months. Most of the work would take place during weekday/daytime hours; however, construction activities may be conducted during nighttime hours or on weekends/holidays, if necessary to maintain schedule. Construction-related noise impacts could occur from the construction activities themselves, the vehicular traffic associated with construction workers and materials moving to and from the plant.

Impacts of construction noise depend on the phase of construction, number of pieces of construction equipment utilized, equipment noise generation levels, the usage of the equipment, and the phase of construction. The first phase is site improvement and/or clearing and preparation and uses compactors, front loaders, scrapers, excavators, graders, and miscellaneous trucks. The next phases involve construction of the additional limestone preparation area and ball mills, the FGD system itself located downstream of the existing Unit 3 precipitator, a new stack, and a new gypsum handling system. Concrete mixers, cranes, pumps, generators, and compressors would be of most use during this phase. The last phase involves the type of work that generally does not use equipment that produces a significant amount of noise, such as clean up and testing. In general, the noise associated with construction equipment and the assembly operations is very similar to noise from current operations and would be nearly indistinguishable in and around the plant by most observers. Because of the intermittent nature of the activities, the similarity of these sounds to noises already generated at the plant during normal operation, and the distance to potential receptors (more than 2 miles), noise impacts during construction would be insignificant.

Since no potential receptors (i.e., homes or nonindustrial businesses) exist along SR 176, the noise impacts of construction-related traffic in the following is based on an assessment of noise from vehicles passing receptors situated along U.S. Highway 431 which passes north-south through Drakesboro. Traffic arriving and departing the plant would use both the north and south portions of U.S. Highway 431, but the percentage split is not known. Since the homes and residences located in the immediate vicinity of the 431/176 intersection would experience all traffic, the assessment of impacts herein is conservatively based on all traffic leaving and departing the site. According to the Kentucky Department of Transportation, traffic counts for the year 2001 (See Section 3.12), U.S. Highway 431 currently had an “Average Daily Traffic” (ADT) count of 6,854 vehicles per day. SR 176, leading to the plant from the intersection with U.S. Highway 431 at Drakesboro, had an ADT of 2,795 vehicles per day. It is assumed that any new vehicular traffic would be similar to the traffic now experienced on area roadways (i.e., the noise from the additional vehicles would be very similar to the noise from current vehicles).

Truck traffic associated with the proposed project would be intermittent and infrequent throughout the 21-month period; there would be perhaps three to five trucks per day during the first several months to deliver equipment, materials, and supplies. Trucks would range in size from small vans to semitrucks. The addition of this traffic to existing traffic counts would be minimal; thus, its contribution to current noise levels would be insignificant.

Construction workers arriving and departing the site (see Section 2.1.9) would number less than 300 during any month and less than 200 except for about 10 months during peak construction effort. Assuming no car pooling, the number of vehicle trips related to construction worker traffic alone would, at most, nearly equal the current permanent staff at the plant. During peak months, construction worker traffic would represent an increase of 21 percent, over current levels on SR 176, but less than a 9 percent increase on U.S. Highway 431. Since these levels would exist for only a few months, and reflect predominantly automobile and small truck traffic, impacts to residents along U.S. Highway 431 would be minimal. The actual peak increase would be well less than 9 percent since workers would likely arrive from points of origin both north and south of the 431/176 intersection. This slightly increased frequency of noise events is unlikely to be noticed by residents in the area. One additional mitigating factor is that most traffic associated with the construction of the new scrubber would be daytime during weekdays, and would not incrementally change the noise now experienced at night or on weekends along area roadways.

*Noise – Operational Impacts* – In order to form a basis for modeling of the total noise levels from both the existing plant operations and the new FGD system and related new limestone preparation operations, noise levels from the existing plant operation were measured during a noise level survey on August 22, 2002. That information is contained in Table 3-9 and represents normal summer full operating load conditions of Units 1 and 2 (rated at approximately 704 MW each) and Unit 3 (rated at 1,056 MW). Two of the three existing ball mills were operating (35 tons per hour each), and coal, limestone, and ash removal trucks were operating on a normal schedule. Overall noise levels from current plant operations were monitored at the top of a closed solids disposal area approximately one-fourth mile west of the plant area (Location 2), the ball mill noise levels were monitored at Locations 3 and 4, and Unit 1 noise levels were monitored at Locations 5 and 6.

The noise-producing activities related to the proposed project were separated into three distinct activities, and estimates made of the noise impacts of each. Those three activities are truck delivery operations for the additional limestone needed for the Unit 3 scrubber, operation of the new ball mill, and operation of the new scrubber. Each of these three noise-producing activities is reviewed below.

According to TVA projections, the delivery of limestone to the plant could more than double the existing 330,000 tons per year to as much as 740,000 tons per year. Current limestone deliveries are made by truck. By estimating 25 tons of limestone per truck with deliveries made only on weekdays during the day shift, it is estimated that 51 trucks per day currently deliver limestone to the plant. To deliver the additional 410,000 tons per year, utilizing similar criteria, 63 additional trucks per day would be required, for an approximate total of 114 trucks. Table 3-12 contains the noise levels measured under a variety of conditions associated with limestone delivery. Noise measurements were made approximately 25 feet from the center of the roadway. These values were adjusted to represent their level at 100 feet since this is a more typical distance between houses and the roadway along U.S. Highway 431.

| **Table 3-12. Noise Impacts From Limestone Truck Delivery** | | |
|---|---|---|
| **Monitoring Location – Haul Road No. 1** | **Existing Noise Levels (dBA)** | **Projected Noise Levels at Residences Located 100 Feet From Roadway (dBA)** |
| *(Distance is 25 feet from the center of the roadway - duration of each vehicle noise event is approximately 30 seconds.)* | | |
| One truck proceeding toward plant (slightly downhill) | 68.3 | 56.26 |
| Two trucks proceeding together away from plant (slightly uphill) | 78.1 | 66.06 |
| One truck going away from and one truck going toward plant | 76.6 | 64.56 |
| “Average” of mixed truck noise | 74.3 | 62.26 |
| “Average” of mixed truck noise after additional construction and/or operational truck traffic is added | 74.3 | 62.26 |

By using the average time of approximately 30 seconds that each truck generates noise as it passes by a certain point, and computing the three normal instances of truck activity noted in the above table, we can use simple multiplication to determine an “average” noise level for the mixed truck traffic events.

As noted in the discussion of construction noise impacts above, no potential receptors (i.e., homes or nonindustrial businesses) exist along SR 176. Consequently, the noise impacts of increased truck traffic are based on an assessment of noise from these vehicles passing receptors situated along U.S. Highway 431. Using data presented above relative to existing daily traffic counts on area roads, 63 additional limestone trucks would represent an increase in truck traffic of less than 1 percent. Such an increase would not be noticeable to residents living along U.S. Highway 431, nor detectable by typical noise measuring instruments. It is assumed that any new vehicular traffic would be similar to the traffic now experienced on area roadways (i.e., the noise from the additional vehicles would similar to the noise from current vehicles). It is concluded that the noise from additional trucks delivering limestone to the plant would have insignificant impacts to residents living along haul routes. If rail or a combination of truck and rail is used for limestone delivery, noise impacts would be even lower.

To prepare limestone for the new FGD system, two new horizontal ball mills would be constructed (each with 45 tons per hour capacity), but only one would be operated at a time. The noise specification for the proposed ball mills is conservative (85 dBA overall sound pressure level at a distance of 3 feet from the equipment surface of each ball mill). This specification is substantially less than noise emanating from the current ball mills. Therefore, two assessment scenarios were considered, one utilizing the 85 dBA criteria contained in the vendor specification instructions and one (more conservative) assuming that the noise from the new system would be the same as the existing ball mill system when two of the three ball mills are operating, which is the normal operating procedure.

The new ball mills would be placed near the existing ball mill building. Two of the existing ball mills would continue to serve Units 1 and 2, while one of the two new balls would serve Unit 3. Utilizing the noise propagation formula discussed in Appendix D, noise levels at 3 feet from the source (near field) and 400 feet from the source (far field) were calculated. This resulted in an estimated near field (3 foot) noise level of 95 dBA (based on Location 3 measurements) and 99 dBA (based on Location 4) for the existing ball mill. Location 3, situated 100 feet from the existing ball mill, is probably the most accurate measurement of the ball mill by itself. Location 4 measurements were taken at 400 feet and may have included cooling tower noise coming over the top of the ball mill building.

If we assume that the new ball mill system operates at the vendor's specification of 85 dBA (near field), according to the noise level addition formula in Appendix D, there would be no increase in nearby noise due to the dominating influence of the existing ball mill noise in the "total noise" computation (because of the way two noise levels are added to one another, see Appendix D). If the new ball mill operates such that it generates noise at a level similar to the old ball mill, the impact would still be minimal. This is because the incremental noise from the new ball mill, even including the noise from the existing ball mills, would dissipate to background noise levels within approximately 2,390 feet of the ball mill. Consequently, since no noise receptors are located within 2 miles of the plant, noise impacts from the new ball mill would be negligible.

The new FGD system also has very conservative noise limit specifications which vendors are required to meet. Slurry pumps, pump motors, modulating control valves, valve motors, oxidation air system blowers and blower motors, agitation system motors, and induced draft fan motors all have vendor specifications requiring noise levels not to exceed 85 dBA at 3 feet from the equipment surface. These limits would help keep the FGD system operating noise levels low. However, based on the distance of these individual pumps from each other, because of the additive effect of noise sources located in close proximity of each other, the total FGD operating noise level is likely to be higher than the 85 dBA listed for the individual pieces of equipment.

In general, when the additional operating noise combined with the background noise levels (i.e., logarithmically added to the background) causes an incremental increase of 3 dBA or more above background noise levels, the noise increase is considered noticeable. This threshold is based on the Federal Interagency Committee on Noise (FICON) determination that a 5 dBA increase above background levels at 55 dBA, a 3 dBA increase above background levels at 60 dBA, and a 1.5 dBA increase at 65 dBA all represent the same relative impact, and all are therefore equally discernible to the hearer (FICON, 1992). To be conservative in our approach, the threshold was set at 3 dBA, even though current USEPA guidelines would suggest the use of a 5-dBA threshold for intruding operational noise in this situation.

Noise impacts of the FGD system were calculated two ways: first, utilizing the vendor specification noise data and second, utilizing measurements made during the August 22 survey of existing noise near Unit 1. The results of both scenarios are presented in Table 3-13.

**Table 3-13. Noise Impacts for Unit 3 FGD System**

| Location Distance From Plant (feet) | Existing Noise Levels (dBA) | Projected Noise Levels – Vendor Data (dBA) | Increase Over Existing Levels (dBA) | Projected Noise Levels - Existing Data (dBA) | Increase Over Existing Levels (dBA) |
|---|---|---|---|---|---|
| 2 (1320) | 44.5 | 44.5 | 0 | 47.5 | 3.0 |
| 3 (400 ) | 54.86 | 54.86 | 0 | 57.86 | 3.0 |
| 4 (400) | 59.20 | 59.20 | 0 | 62.20 | 3.0 |
| 6 (400) | 62.78 | 62.78 | 0 | 65.78 | 3.0 |
| 7 (8976) | 40.3 | 40.3 | 0 | 40.3 | 0 |
| 8 (10560) | 40.4 | 40.4 | 0 | 40.4 | 0 |

Utilizing the vendor data and assuming that the individual sources are far enough apart from each other so as not to have an additive noise effect, there would be no increase in the new system noise levels from the existing operations at any of the locations where measurements were made August 22 (see Table 3-13). It is important to note that none of these locations are at a point where a member of the public would be exposed to plant noise. Based on vendor noise data, it is concluded that the impacts of noise from the proposed FGD system would be insignificant.

If we assume the noise levels from Unit 3 will be the same as found in the study of Unit 1, the new FGD system would have an additive effect of approximately 3 dBA at the points where measurements were taken on August 22, all of which are within 400 feet of the plant. In this case, the additional noise would dissipate into existing background levels at approximately 5,950 feet from the plant. However, since no noise receptors are located within 2 miles of the plant, FGD operating noise impacts would also be negligible under this very conservative scenario.

Finally, an attempt was made to determine the distance from the plant at which noise from the proposed project would dissipate to background levels and the distance at which noise would not be noticeable. A level is assumed equivalent to background noise if the difference is 1 dBA or less. A level is assumed not to be noticeable if it is no higher than 3 dBA over background noise. A 3-dBA incremental increase over background is defined in FICON as being clearly noticeable to a hearer (1992). The results are shown in Table 3-14.

Three different noise attributes are shown in Table 3-14. The existing scrubber noise (represented by the noise data from Unit 1) is highly directional to the northeast toward Green River, because the mass of the power building is directly behind it to the southwest, which acts as a barrier and as a reflective source. The new FGD scrubber system would be oriented more to northwest. It is represented in the table below by the noise attribute "total plant operation," which would approximate the noise generated by the plant as a whole to the north, west, and south after the planned additions. The existing and new ball mills are oriented toward the southwest, and the noise in that direction is somewhat directional because of noise reflecting from the cooling towers. By including all three noise attributes, a more comprehensive picture of the total noise promulgation from the plant may be obtained after including the planned additions.

Based upon these considerations, it is concluded that noise impacts from operation of the proposed project are minimal to TVA staff working in and around the plant, and insignificant to members of the public.

**Table 3-14. Distance at Which Additional Operating Noise Dissipates to Background and "Not Noticeable" Noise Levels**

| Noise Attribute | Distance at Which Operating Noise Equals Background Noise (feet) | Distance at Which Operating Noise is Not Noticeable (feet) |
|---|---|---|
| Ball Mills Operation | 2385 | 1690 |
| Scrubber Operation | 5950 | 4200 |
| Total Plant Operation | 3000 | 2130 |

## 3.6. Cultural Resources

### *3.6.1. Affected Environment*

*Archaeological Resources* – Numerous archaeological sites have been recorded along the terraces and bottoms of the Green River in Muhlenberg County. Of particular note is the Indian Knoll site, which is located immediately across the river from PAF. Extensive archaeological investigations of Indian Knoll have provided important information on the prehistoric Middle Archaic Period (circa 6000-3000 B.C.) of human occupation of the Green River Valley.

The affected environment for archaeological resources includes all areas that would be subjected to ground-disturbing activities. Although substantial ground disturbance will occur for this project, all areas of disturbance will take place in existing disturbed locations within the plant site. The previous disturbance of the PAF site is so extensive that it would be extremely unlikely that any archaeological sites have survived the disturbance. Therefore, no archaeological resources exist within the affected environment of this project.

*Historic Structures* – PAF construction was begun in 1959 with operation beginning in 1963. The plant is not yet 50 years old and therefore is not eligible for listing on the National Register of Historic Places (NRHP). There are no structures potentially eligible for listing on the NRHP within the footprint of PAF.

The haul route(s) for transporting limestone from the quarry to PAF is also part of the affected environment. There are several possible sources of limestone. Since the successful contract bidder(s) for supply of limestone for the scrubber(s) will not even bid or be known until 2005-2006, two representative quarry supply routes were selected for evaluation, i.e., the Rogers Group in Princeton and Martin Marietta in Fredonia.

- Rail Route: Existing rail routes are available to both quarries and connect to PAF.

- Truck Route – Princeton: Rogers Group Quarry is 3 miles south of Princeton on SR 91. The haul route north to the Parkway passes through rural agricultural areas with sites potentially eligible for listing on the NRHP. The route then passes through the historically significant city of Princeton, an historic district listed on the NRHP. This district is roughly along Main Street East and West Court Square streets; approximately 210 acres.

- Truck Route – Fredonia: Martin Marietta Quarry is located 3 miles south of Fredonia on U.S. Highway 641. The haul route south to the Parkway passes through rural agricultural areas with sites potentially eligible for listing on the NRHP.

- Truck Route – Western Kentucky Parkway to PAF: From both quarries, the truck route would continue along the Parkway, exiting at Central City to U.S. Highway 431/70 continuing south 7 miles to Drakesboro, then east to PAF. The Parkway is a major four-lane, divided highway with extensive traffic. U.S. Highway 431/70 to Drakesboro is a recently improved, realigned highway that bypasses the older farms, homes, and communities along the old route. There are no structures potentially eligible for listing on the NRHP along this route, at the junction in Drakesboro, or along the road to PAF.

### *3.6.2. Environmental Consequences*

*Archaeological Resources* – Because of the extensive ground disturbance that has occurred over the entire plant site during the history of the plant, there are no areas of the site that are likely to contain archaeological resources. Because all ground-disturbing activities would take place within previously disturbed areas of the plant, no archaeological resources would be affected by the construction of the Unit 3 $SO_2$ scrubber or other associated construction.

*Historic Structures* – PAF does not meet the requirements to be eligible for listing on the NRHP, and there are no structures potentially eligible for listing on the NRHP in the Area of Potential Effect of PAF. Therefore, there are no environmental consequences concerning historic structures resulting from the proposed action at the plant site.

Among the potential suppliers, two representative quarries were evaluated for supplying limestone to PAF, i.e., Rogers Group, Princeton, and Martin Marietta, Fredonia. The possible haul route is by either rail or truck.

- Rail Route – Existing rail routes are available to both quarries and connect to PAF. Since existing rail routes would be used and deliveries would not add a substantive number of additional trains passing, rail service will not result in additional impacts to historic structures.

- Truck Route – Princeton: Rogers Group Quarry is 3 miles south of Princeton on SR 91. The haul route north to the Parkway passes through rural agricultural areas with sites potentially eligible for listing on the NRHP. The route then passes through the historically significant city of Princeton and its historic district listed on the NRHP. The main traffic routes through the district already carry local residential and business, as well as commercial (heavy truck), traffic. The total additional 63 trucks passing through the historic district for the Unit 3 scrubber addition would constitute only about a 1.6 percent increase in total Average Daily Traffic (ADT) of vehicles (a change from the current 3,842 vehicles per day to 3,905 vehicles, see Transportation Section), and the total 113 trucks per day for all three units scrubbers would subsequently constitute only a total of about 2.9 percent of ADT. However, heavy truck traffic also has a disproportionably greater potential for impact to an historic district via additional noise, visual impacts, and potential dust and air emissions. If unmitigated, the additional haul trucks passing along this route would have an adverse impact on this NRHP-listed historic district. In order to ensure that impacts are not significant, if this delivery route were selected, TVA would: (1) typically receive limestone deliveries during normal weekday business hours; (2) require the contractor to use appropriate load covers and dust control of delivery trucks, to maintain delivery trucks in good operating condition with regard to emissions and noise, and stipulate staggering of truck shipments (perhaps 2 or 3 at a time) to reduce the frequency of heavy truck traffic passing through the area. In the event that the successful bidder (in 2005-2006) for supplying the limestone were to specify truck delivery via this route, TVA would also stipulate in the contract those mitigation measures appropriate (if any) for the successful bidder to implement. At that time, TVA would additionally consult with the Kentucky SHPO to confirm these measures as effective and feasible mitigation to minimize incremental TVA impacts to the historic district

- Truck Route – Fredonia: Martin Marietta Quarry is located 3 miles south of Fredonia on U.S. Highway 641. The haul route south to the Parkway passes through rural agricultural areas with sites potentially eligible for listing on the NRHP. Though the truck traffic would have an impact, the farm complexes are set back sufficiently from the roadway where the impact would not be adverse.

- Truck Route – Western Kentucky Parkway to PAF: From both quarries, the truck route would continue along the Parkway, exiting at Central City to U.S. Highway 431/70, continuing south 7 miles to Drakesboro, then east to PAF. The Parkway is a major four-lane, divided highway with extensive traffic; the additional truck traffic would not be an impact on historic structures. U.S. Highway 431/70 to Drakesboro is a recently improved, realigned highway that bypasses the older farms, homes, and communities along the old route. There are no structures potentially eligible for listing on the NRHP along this route, at the junction in Drakesboro, or along the road to the plant. This segment of the truck haul route would not have an effect on historic structures.

## 3.7. Coal Combustion Byproduct Generation, Handling, and Disposal

### *3.7.1. Affected Environment*

*Fly Ash* – During the most recent year for which complete records are available, Units 1 and 2 burned a total of 3,536,617 tons of coal, and Unit 3 burned a total of 2,642,432 tons. Average ash content of the coal burned for all three units was 8.46 percent. Fly ash production for Units 1 and 2 totaled 59,910 tons and was 55,887 for Unit 3. Currently, all of the fly ash for Unit 3 is sluiced directly to the Jacobs Creek Ash Pond (JCAP). The rest of the fly ash for Units 1 and 2 is captured by the scrubbers and is sluiced with the scrubber gypsum to the scrubber gypsum stacking area where it is co-managed with the scrubber gypsum. The scrubber gypsum/fly ash mixture from Units 1 and 2 is sluiced at about 12 percent solids to the scrubber gypsum stacking area where the solids settle out by gravity and the resulting supernatant discharges through a series of settling ponds to the JCAP.

Since PAF does not have a dry fly ash system and all fly ash is handled wet, no fly ash is currently sold. Small amounts of fly ash have been reclaimed from the JCAP or from dredge cells from time to time and used in dike construction at the ponds. At the present time, wet fly ash does not have any commercial use.

*Scrubber Gypsum* – Operation of the FGD scrubbers on Units 1 and 2 result in production of about 540,000 tons of scrubber gypsum/fly ash mixture per year. This material is sluiced to the scrubber gypsum stacking area where it is allowed to dewater in a series of ponds operated as rim ditch stacks. Once the material has dewatered, it can be used in a variety of applications. Although none of the scrubber gypsum material from PAF has been marketed commercially, varying amounts have been used in construction and land reclamation projects on the plant site including the raising of SR 176 on the plant reservation, dike construction, and land reclamation on the coal wash refuse stacking areas southwest of the coal wash plant operated at PAF. Although the material in its present form is not suitable for use in gypsum wallboard manufacturing, at least one company is evaluating the feasibility of processing the material to improve gypsum purity and to remove the fly ash contamination. If successful, this could result in the use of up to 400,000 tons of gypsum material annually.

The recent addition of SCR systems on units at PAF make it possible for excess ammonia (ammonia “slip”) to end up on the scrubber discharge. The presence of ammonia in the scrubber gypsum material probably would not affect its suitability for use in gypsum wallboard manufacturing because the material would be calcined (heated to over 400 degrees F to drive off water of hydration and form “stucco” or plaster of Paris). The heat involved in calcining would probably be sufficient to drive off residual ammonia so that the wallboard produced from this material would have no detectible odor problems. However, removal of the ESPs from Units 1 and 2, which resulted in all of the fly ash from these two units being captured in the scrubber gypsum, made it less likely that the scrubber gypsum would be economically processed to improve gypsum purity and to reduce fly ash contamination. PAF scrubber gypsum could potentially be used as asphalt filler, daily cover for municipal landfills, soil amendment in agricultural applications, and as a set retardant in concrete mixtures. The presence of more fly ash in the scrubber gypsum caused by removal of the ESPs will not impact these potential uses, but the presence of detectable ammonia odors could prevent its use in agricultural applications, daily cover for municipal landfills, and as a set retardant in concrete. Therefore, it is unlikely that a market in wallboard manufacturing could be successfully developed for this material from Units 1 and 2.

Addition of the LSFO scrubber on PAF Unit 3 would generate an additional 450,000 tons of scrubber gypsum annually. However, ESPs on Unit 3 will be retained, so the Unit 3 scrubber gypsum will not be contaminated with fly ash. Therefore, the material should meet specifications for commercial use in cement and wallboard manufacturing. If a market can be developed for substantial amounts of this material, the gypsum would probably be diverted for processing prior to disposal. The addition of processing facilities, if required, will be addressed in a future NEPA review.

*Boiler Slag* – The three cyclone units at PAF produce about 450,000 tons of boiler slag annually, which accounts for 70-80 percent of the ash production. This material is produced as a molten ash in the bottom of the boiler and is quenched in water to form the hard, glassy slag. This material is also called bottom ash. This material is then sluiced to a series of settling ponds, Boiler Slag Ponds 2A, 2B, and a stilling pond. There the material is reclaimed by Reed Minerals and removed for processing. Reed is able to reclaim about 90 percent of the boiler slag. About 5-10 percent is too fine to be captured by the equipment used in the pond and settles out as slag fines in the ponds. The fines are dredged to other areas about every 5 years to maintain free water in the ponds. The slag processed by Reed Minerals is sold for use as industrial abrasives and for roofing granules.

### *3.7.2. Environmental Consequences*

Adding LSFO scrubbing on PAF Unit 3 will almost double current scrubber gypsum production at PAF. If this material is not marketed, it will be disposed of in a discrete part of the existing scrubber gypsum stacking area, segregated so that it could be reclaimed at a future date if a market is developed. Disposal in the existing stacking area would not result in any significant impacts related to solid waste disposal. The current gypsum stacking area has capacity for at least 20 years of gypsum stacking at current production rates. The addition of 450,000 tons per year would reduce this capacity to 14 years if no gypsum marketing occurs. With gypsum marketing, the life of the gypsum stacking area would be commensurately increased. Depending upon when the active life of the gypsum stack is exhausted, a new facility would need to be developed. Siting and development of that facility would be done in accordance with regulations in effect at the time of development.

## 3.8. Surface Water and Wastewater

### *3.8.1. Affected Environment and Existing Wastewater Treatment Systems*

*Plant Intake* – The initial source for all process wastewater at PAF except for the sanitary wastewater, is the Green River. The lower Green River is listed in the Kentucky Report to Congress on Water Quality (Kentucky 305b Stream Assessments) as "Fair," only partially supporting its designated uses. The listed pollutants of concern include other habitat alteration, pH, salinity/total dissolved solids/chlorides, and pathogens. The listed probable sources of pollutants are resource extraction, land disposal, and agriculture. A sample of the Green River from the PAF intake on April 11, 2001, had the following water quality characteristics:

- pH — 7.4 standard units (s.u.)
- specific conductance — 250 micromhos
- "M" alkalinity — 92 ppm, as Calcium Carbonate
- Chloride — 10 ppm, as Chlorine
- Hardness, total — 124 ppm, as Calcium Carbonate
- Iron, total — 2.8 ppm, as Iron

*Existing Coal Combustion Byproducts (CCB) Wastewater Treatment Facilities* – The existing CCB handling systems include several areas which receive and treat CCB wastewater streams including: JCAP and its stilling pond; Boiler Slag (Bottom Ash) Ponds (BAP) 2A, 2B, and stilling pond; and FGD scrubber gypsum areas and settling ponds. The locations of several of these ponds are shown on Figures 2-2 and 2.3.

*Jacobs Creek Ash Pond (JCAP)* – About 8.3 percent of coal burned at PAF remains as ash, of which approximately 70 percent is boiler slag and 30 percent is fly ash. All ash is handled/sluiced wet, not dry. Most of the fly ash from Units 1 and 2 is currently captured by the existing FGD system and is sluiced with the scrubber gypsum to the gypsum stacking areas. All of the fly ash from Unit 3 is sluiced to the JCAP at an average annual flow of

10.944 million gallons per day (mgd). Economizer fly ash is incorporated into the molten slag tank. Air preheater ash is sluiced to JCAP. Some ash is collected at the Selective Catalytic Reactor (SCR) in ash hoppers and then sluiced to the JCAP.

Three sources (fly ash sluice, boiler slag (bottom ash) sluice, and FGD) currently comprise 97 percent of the total JCAP flow, as shown in Table 3-15 below. Direct storm water runoff is approximately 2 percent of the total flow, and all other sources make up the remaining 1 percent. These flow values are based on information gathered for the current KPDES permit application and represent average flows on an annual basis.

**Table 3-15. Inflow Sources to Jacobs Creek Ash Pond, Average Annual Flows, and Percent of Total Discharge DSN001**

| Source | Inflow to Jacobs Creek Ash Pond (mgd) | Percent of Total JCAP Discharge (DSN001) |
|---|---|---|
| Fly Ash Sluice Water | 10.944 | 34 |
| Boiler Slag (Bottom Ash) Pond Stilling Pond | 16.85 | 52 |
| FGD Ponds | 3.617 | 11 |
| Chemical Metal Cleaning Waste (DSN007) | 0.033 | 0.1 |
| Air Preheater Wash Water Sumps | 0.016 | 0.05 |
| Internal Dredge Cells Drainage | 0.1532 | 0.5 |
| Old FGD Landfill and Refuse Stacking Area | 0.0068 | 0.02 |
| Reclaimed Strip Mine Area Drainage | 0.2373 | 0.7 |
| Direct Storm water Runoff | 0.685 | 2 |
| Precipitator Wash Water Sump Unit 3 | 0.027 | 0.1 |
| **Total** | **32.57** | **100** |

The JCAP, expanded in 1997 to meet estimated ash disposal requirements until the year 2035, is approximately 127 acres in size. The JCAP provides passive physical settling of suspended solids and limited metals precipitation before treated water overflows to a stilling pond. Effluent (about 33 mgd) from the JCAP stilling pond is discharged into Jacobs Creek through KPDES Outfall DSN001. Normal operating conditions can result in lower JCAP discharge flows in the range of 17-20 mgd. The influent flows to JCAP in Table 3-15 above may or may not vary accordingly. Some inflows, such as storm water runoff, vary with precipitation. Under extreme low flow conditions, such as major unit outages, the JCAP discharge flows could be as low as 11-13 mgd. However, these extreme conditions are unlikely, occur very infrequently, and will not be evaluated in this EA.

The JCAP discharge is generally pH neutral. On occasions when the effluent pH approaches the upper pH limitation of 9.0 s.u., a $CO_2$ injection system is used for control. A numerical model, FLOWPATH, for determining leachate fluxes at the pond boundaries indicated that pond leachate entering Jacobs Creek is minute compared to the surface discharge to the creek.

TVA is required under KPDES Permit No. KY0004201 to meet pH, total suspended solids, oil and grease, and chronic WET limits on the JCAP discharge. The KPDES permit also requires that DSN001 (and the BAP DSN002) be monitored for a series of total recoverable metals, but there are no current limitations for these metals. The scrubber pond can contribute dissolved metals to the JCAP. Potential impacts of these metals or other constituents are indicated by the toxicity testing performed at DSN001, and appropriate actions are taken to address these issues as required by the permit. As part of the regular permitting cycle, a request for a permit renewal has been submitted to the state of Kentucky.

*Boiler Slag (Bottom Ash) Ponds* – Boiler slag from all three units is sluiced first to BAP 2A where suspended solids are settled. The boiler slag sluice flow averages 29.64 mgd. Much of the settled slag is reclaimed by Reed Mineral (see Section 3.7.1). Precipitation runoff from the coal storage area drains to three separate ponds and is pumped to the BAPs. Pond 2A discharge flows through a culvert to BAP 2B for further settling. Pond 2B discharges into a stilling pond and the stilling pond discharges into the Green River through Outfall DSN002. A pump platform is located at the head of the stilling pond where an annual average of 16.85 mgd is pumped from the BAP to JCAP (DSN001). The DSN002 discharge to the Green River has an average flow of 25.13 mgd and usually has a pH of approximately 7.4 s.u. TVA is required under KPDES Permit No. KY0004201 to meet pH, total suspended solids, oil and grease, and acute toxicity limits on this discharge (DSN002).

*FGD Scrubber Gypsum Byproduct Ponds* – There are existing FGD scrubbers on Units 1 and 2 that remove 85 percent of the flue gas $SO_2$ from these units. Removal of the ESPs on Units 1 and 2 to facilitate installation of the SCR system resulted in most fly ash removal being performed by the FGD system. FGD makeup water and the lime feed slurry total 3.15 mgd. When the gypsum concentration reaches about 15 percent, solution blowdown is initiated to maintain equilibrium. This blowdown stream is pumped to the gypsum stack (rim-ditch stacking operation). The FGD system includes several areas that drain into the FGD stilling pond. The flow path is switched routinely by plant personnel in response to operational needs. The FGD stilling pond discharges to the JCAP through the FGD channel which is approximately 1 mile long and 5 feet wide. Other operations and runoff from other areas contribute an additional 0.46 mgd to the FGD scrubber gypsum byproduct ponds system flow.

PAF has added SCRs on Units 1 and 2 to reduce $NO_x$ emissions in their stack gases. The SCRs were added to Unit 2 and Unit 1 in the spring of 2000 and 2001, respectively. The SCR for Unit 3 would be added in the spring of 2003. Some ammonia may slip through the SCRs. Most of the ammonia slip would be removed from the stack gases in the FGD scrubber for that unit and become part of the FGD scrubber gypsum byproduct pond wastewater.

*Limestone Storage Runoff Ponds* – The existing FGD scrubbers on Units 1 and 2 use approximately 330,000 tons/year of limestone for current operations. This limestone is currently delivered by truck and stored prior to grinding in ball mills. The runoff from the limestone storage area is directed to a settling pond, which then discharges through Red Water Ditches #5 and #1 to the BAP described above. This runoff, which also includes runoff from the cooling tower area, is approximately 0.0618 mgd on an average annual basis.

*Other Surface Runoff* – The existing plant site runoff is regulated under the KPDES Permit KY0004201. Existing facilities and BMPs are used to ensure compliance with the permit conditions. Some plant runoff is directed through the JCAP and the BAP systems discussed above, while other runoff goes directly to the Green River through permitted discharge points.

*Sanitary Wastewater Treatment* – Most sanitary wastewater at PAF is treated on site in a small, extended aeration package plant that discharges as Outfall DSN004 to Red Water Ditch #1. Red Water Ditch #1 then discharges to the BAP. DSN004 has limitations on $CBOD_5$ (carbonaceous biochemical oxygen demand) and fecal coliform bacteria. The average annual flow from DSN004 is 0.02 mgd. This is from approximately 315 permanent staff during the day shift; approximately 54 permanent staff members on the night shift; and another 39 on midnight shift. During outages, an additional 100 workers may be on site. During outages, portable toilets are provided because of the distance to the permanent sanitary facilities. Portable toilets will also be provided for use by FGD project construction personnel as described below.

*Whole Effluent Toxicity (WET)* – KPDES Permit No. KY0004201 has a chronic WET limit on JCAP DSN001, requiring quarterly monitoring. The permit currently contains a WET limit of 1.0 chronic toxicity units based on a 7-day exposure of the fathead minnow, *Pimephales promelas*. This permit limit is based on a 25 percent inhibition concentration ($IC_{25}$) test endpoint in undiluted effluent, which means that exposure to undiluted effluent resulting in reductions of mean fish growth (based on initial numbers of test organisms) by 25 percent or more would constitute a permit violation.

Compliance with WET limits appears to be related to the fuel types in use. Historically, when PAF burned more eastern bituminous coal, which has less alkalinity, DSN001 occasionally experienced higher toxicities in the discharge. Since PAF began burning a mixture of Powder River Basin and eastern bituminous coal (with a resulting higher alkalinity), DSN001 toxicity has not been an issue.

KPDES Permit No. KY0004201 has an acute WET limit on BAP DSN002. The permit currently contains a WET limit based on acute 48-hour static toxicity tests with the daphnid, *Ceriodaphnia dubia.* This permit limit is based on a 50 percent lethal concentration ($LC_{50}$) in undiluted effluent, which means that exposure to undiluted effluent resulting in reduction in survival by 50 percent or more would constitute a permit violation. The BAP discharge (DSN002) has not experienced any significant toxicity.

### *3.8.2. Environmental Consequences*

Under the No Action Alternative, plant surface runoff and permitted discharges would be unchanged due to scrubber construction, so wastewaters and their receiving surface waters would not be affected.

Changes in wastewater streams would occur during construction and operation of the proposed FGD systems. The following sections describe these changes and potential impacts on plant effluents and their receiving surface waters.

*Construction Impacts* – Wastewaters generated during construction of the proposed Unit 3 FGD scrubber system may include construction storm water runoff, domestic sewage, dewatering of work areas, nondetergent equipment washings using BMPs, and hydrostatic test discharges. All construction activities would be within the existing plant site. Surface runoff would flow to existing facilities that must meet regulatory requirements. In addition, a Construction Storm Water Permit will be in effect which requires the development of a project-specific Storm Water Pollution Prevention Plan. This plan will identify specific BMPs to address construction-related activities, which would be conducted accordingly, to ensure that storm water impacts are minimized and that no sediment or other polluting materials are introduced into receiving waters. Thus, no significant impacts to either Jacobs Creek or the Green River are expected from construction activities.

A conservative peak estimate for workers on site at any one time during the scrubber project would be 815. This is based on 400 for scrubber construction (all day shift); 315 permanent plant staff (day shift); plus an additional 100 people for a plant outage that could occur during a peak month. Portable toilets would be provided for the additional scrubber construction workforce (400). Outages occur routinely and those additional workers (100) would be handled by appropriate combinations of portable toilets and existing sewage treatment facility depending on the workforce location. All portable toilets would be regularly pumped out and the sewage transported by tanker truck to a publicly owned treatment works accepting pump out. The on-site sewage treatment plant, regulated under the PAF KPDES permit as DSN004, would be operated to ensure compliance with its effluent limitations.

*Operational Impacts* – Under the No Action Alternative, plant surface runoff and permitted discharges would be unchanged due to scrubber construction or operation, so wastewaters and their receiving surface waters would not be affected.

During operation of the proposed Unit 3 FGD scrubber system, surface runoff and domestic sewage flows should not be significantly different from current wastewaters of this type. The wastewater streams, which could change substantively under the Proposed Alternative, are the FGD scrubber system wastewater, the fly ash sluices, the boiler slag sluices, and the surface runoff from the expanded limestone handling area. The operation of the proposed Unit 3 scrubber would increase the existing FGD pond effluent flow, but little change in FGD effluent quality is expected. The flows of the fly ash sluice and bottom ash sluice would not change, but the chemical characteristics of the fly ash sluice would change as a result of burning higher-sulfur eastern coal. The chemical characteristics of the boiler slag sluice and the limestone handling area may not change substantively.

No direct negative (toxic) impacts on the receiving streams (Jacobs Creek and the Green River) would be anticipated because both DSN001 (JCAP effluent) and DSN002 (BAP effluent) would be required to meet NPDES WET limits. Mitigative actions discussed below and noted in Section 2.4 would be taken to meet requirements for ensuring that discharges meet WET limits. Thus, the proposed PAF Unit 3 scrubber system and the change to higher-sulfur eastern coal should have no significant impact on the aquatic environment of Jacobs Creek or the Green River.

*Wastewater Management of Additional Scrubber Wastewater* – As in the scrubbers on Units 1 and 2, the proposed addition of a wet LSFO FGD system to PAF Unit 3 would consist of the following:

- One or two absorbers

- A system which receives bulk limestone and prepares a limestone slurry

- A gas handling system that would transport gas from the existing precipitators until emitted from the new stack

- A new gypsum handling system

Unlike Units 1 and 2, which no longer have ESPs, the proposed Unit 3 FGD system would be downstream of the Unit 3 ESP. The Unit 3 adsorber(s) would contain limestone slurry in the lower portion, and oxidation air, which would be sparged or blown into the adsorber liquid, would convert the dissolved calcium sulfite to calcium sulfate (gypsum). As the gypsum concentration reached about 15-30 percent, slurry blowdown will be initiated to maintain design solids equilibrium. The blowdown stream would then be pumped to the gypsum stack. The estimated flow from the proposed Unit 3 FGD is 1.0 mgd. This would increase the total FGD flow to approximately 4.6 mgd and the FGD percentage of JCAP from approximately 11 percent to 14 percent on an average annual basis.

The gypsum from the Unit 3 scrubber would be piped and stacked separately from that of Units 1 and 2 to facilitate marketing, since it would not contain appreciable fly ash because of the existing Unit 3 ESP. This would mean making a few minor changes in the way the pond system is now operated, but no new land would be involved. With the scrubber being operational in 2006, TVA predicts that the existing ponds would accommodate the additional FGD gypsum byproduct for 14 years (assuming none is marketed) or until about 2020.

The limestone for the proposed Unit 3 FGD system would be handled similarly to that for the existing Units 1 and 2. The bulk limestone would be delivered by truck or rail. A conservative estimate for the additional limestone needed for the proposed Unit 3 system is 410,000 tons/year bringing the total to 740,000 tons/year. The runoff from the limestone storage areas would receive primary settling in existing or new settling ponds and then be discharged to the existing CCB wastewater treatment facilities.

The total of Unit 3 scrubber process water and equipment cooling water is estimated to be 5.76 mgd, which would be taken from the Green River. Since this would only increase the current withdrawals by approximately 1.6 percent, this increased withdrawal should not have a significant impact on the Green River.

*Addition of Organic Acids in Scrubber Operations* – The addition of either dibasic acid (DBA) or adipic acid (AA) to enhance $SO_2$ removal efficiencies is being evaluated for its economic cost/benefit. If added, these organic acids (either DBA or AA) would act as a buffer and slow the pH decrease found in the spray tower flue gas contact zone. This would increase $SO_2$ absorption from the flue gas. If the decision is made to use DBA or AA, then thickeners would be added to the scrubber system to enhance scrubber solution reuse and reduce the total demand for DBA/AA. The use of scrubber thickeners would reduce the estimated total FGD flows to JCAP. With use of thickeners, the total FGD flows to JCAP would be sufficiently reduced to avoid potential impacts to surface water or aquatic organisms from effects on WET. The potential impact toxicity of these organic acid additives will be discussed in the section on Toxicity.

As mentioned above, the proposed Unit 3 FGD scrubber system would have different flow combinations and potential impacts, depending on the various operational conditions, including scrubber/thickener combinations and outage status. Appendix C provides a matrix of the various flows and additive concentrations projected as a result of this project and considered as a part of this EA. The current FGD effluent from Units 1 and 2 scrubbers could vary from 0.7 to 3.3 mgd depending on whether thickeners were used to increase the slurry densities from 12 to 15 percent. The lower flow corresponds to the higher slurry density. The proposed Unit 3 scrubber would probably operate at a slurry density of 30 percent with effluent flows of 1.0 mgd.

The expected options and likely boundary conditions being evaluated are summarized in Table 3-16 below. Some of the JCAP flows in the table below are lower than those discussed above to reflect conditions that are more conservative. Reference to DBA in the second column represents the use of one of two possible organic acid additives, either DBA or AA. Discussion of toxicity tests to evaluate the potential impacts on effluent toxicity will be specific for the two organic acid additives.

Potential variations in Units 1 and 2 FGD flows and other operational variables could result in the FGD portion of the JCAP effluent ranging from 1.8 to 22.6 percent with JCAP flows ranging from 17.3 to 39.0 mgd. If Unit 3 were offline concurrently with some extremely low flow ranges, this would produce more extreme conditions, but these flows are very unlikely to occur.

*FGD Toxicity (independent of any use of DBA/AA or thickeners)* – TVA has conducted both field and bench scale studies to better understand both the toxicity-related effects of various FGD concentrations as well as additions of the two organic acids.

Tests conducted to determine the toxicity of FGD, independent of other operational influences (Table 3-17. Chronic Test No. 1) indicated a potential impact on compliance with current or possible future WET limits when the FGD percentage of the JCAP flow reaches or exceeds a concentration of 16-38 percent for fathead minnows and 16-25 percent for daphnids. If chemical additives and slurry thickeners are not used in order to avoid potential toxicity, PAF would need to balance the FGD/JCAP flows after the Unit 3 FGD is in operation so that the total FGD flow is maintained at a percentage of total flow low enough to avoid toxicity. PAF would manage all its processes and systems to avoid exceeding the permit limitations in KPDES0004201. Initially, PAF will manage the flows of the FGD system and the ash ponds so that the total FGD flow does not exceed 20 percent of the total JCAP discharge. This may be achieved by increasing the BAP directed to JCAP by activating a second pump when the FGD/JCAP ratio nears 20 percent. Because there was a range in the lowest ratio (16-25 percent) at which toxicities could occur, additional monitoring would be conducted to confirm or refine this action level following operational start-up of the scrubber and/or any associated fuel changes. Additional mitigative actions that can effectively address the potential toxicity could include adding baffles to the JCAP to increase retention time and enhance JCAP treatment effectiveness or use of other appropriate, comparably effective, technological, or operational measures yet to be identified. The FGD operational commitment is as follows.

**Table 3-16. Paradise Matrix of Operational Flows for PAF Unit 3 FGD Addition and DBA or Adipic Acid Toxicity Testing – October 2002**

| Fly Ash Pond Outfall 001 mgd Basis | FGD and DBA or AA Basis | Units 1 & 2 FGD Effluent | | Unit 3 FGD Effluent | | Fly Ash Outfall 001 mgd | FGD in Fly Ash 001 (%) | mg/L DBA or AA (800 in 1 & 2 FGD) |
|---|---|---|---|---|---|---|---|---|
| | | mgd | Slurry Density (%) | mgd | Slurry Density (%) | | | |
| Flow Used for Aug/Sep Pond Testing, 33 mgd | With PAF Unit 3 FGD, DBA or AA With Thickeners (Assumed Thickeners Dropped Discharge to 0.3 times 3.6 mgd) | 1.08 | 29.5 | 1.2 | 30.0 | 31.7 | 7.2 | 28.3<br>(See Note #1) |
| Expected Water Flow, 26 mgd<br>Chronic Tests #2 & #3 | With PAF Unit 3 FGD, DBA or AA Without Thickeners | 3.3 | 12.0 | 1.0 | 30.0 | 27.0 | 15.9 | 97.8 |
| Low Flow Range, 18 mgd<br>Chronic Tests #4 & #5 | With PAF Unit 3 FGD, DBA or AA with Thickeners | 0.7 | 15.0 | 1.0 | 30.0 | 18.3 | 9.2 | 29.7 |
| Low Flow Range, 18 mgd<br>(Pre PAF Unit 3 Addition, No Thickeners on 1 & 2 FGD)<br>Acute Tests #1 & # 2 | With PAF Unit 3 FGD, DBA or AA Without Thickeners | 3.3 | 12.0 | 1.0 | 30.0 | 19.0 | 22.6 | 138.9 |

**Note 1:** The pond flows were set at the 7.2 percent FGD flow ratio that would be present after PAF Unit 3 FGD addition and with Units 1 & 2 discharging only 0.3 times 3.6 mgd due to addition of thickeners, with thickener discharge going straight to disposal with no additional dilution. Due to slightly higher-DBA concentration prior to PAF Unit 3 FGD going into operation, the DBA concentration was calculated without the 1.2 mgd PAF Unit 3 FGD flow.

mg/L – milligrams per liter

**Table 3-17. PAF Unit 3 Scrubber Addition - Studies - Summary of Toxicity Test Conditions and Results, September-October 2002**

| Test Designation* | Baseline Condition: Percent FGD Pond Effluent (FGD) | Baseline Condition: Percent Bottom Ash Pond Effluent (BAP) | Range in Variable | Toxicity (Fathead Minnows) – BAP Control: Acute (96-hour $LC_{50}$) | Toxicity (Fathead Minnows) – BAP Control: Chronic $IC_{25}$ | Toxicity (Fathead Minnows) – Lab Control: Acute (96-hour $LC_{50}$) | Toxicity (Fathead Minnows) – Lab Control: Chronic $IC_{25}$ | Toxicity (Daphnids) – BAP Control: Acute (96-hour $LC_{50}$) | Toxicity (Daphnids) – BAP Control: Chronic $IC_{25}$ | Toxicity (Daphnids) – Lab Control: Acute (96-hour $LC_{50}$) | Toxicity (Daphnids) – Lab Control: Chronic $IC_{25}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Field Study | 7.2 | 92.8 | 6.25-100% Sample w/28.3 mg DBA or AA/L @100% | >100% | >100% | >100% | >100% | >100% | >100% | >100% | >100% |
| Chronic #1 | 0 | 100 | 6.25 - 75% FGD in BAP | >75% FGD | 43.6% FGD | >75% FGD | 38.4% FGD | >75% FGD | 14.6% FGD | >75% FGD | 15.5% FGD |
| Chronic #2 | 16 | 84 | 25.2 - 150 mg DBA/L | >150 mg DBA/L | >150 mg DBA/L | >150 mg DBA/L | 41.9 mg DBA/L | >150 mg DBA/L | >150 mg DBA/L | >150 mg DBA/L | >150 mg DBA/L |
| Chronic #3 | 16 | 84 | 25.2 - 150 mg AA/L | >150 mg AA/L | >150 mg AA/L | >150 mg AA/L | >150 mg AA/L | >150 mg AA/L | **56.3**/79.4 mg AA/L* | >150 mg AA/L | 63.6/**79.2** mg AA/L* |
| Chronic #4 | 9.2 | 90.8 | 10.1 - 60 mg DBA/L | >60 mg DBA/L | 48.0 mg DBA/L | >60 mg DBA/L | 48.3 mg DBA/L | >60 mg DBA/L | >60 mg DBA/L | >60 mg DBA/L | >60 mg DBA/L |
| Chronic #5 | 9.2 | 90.8 | 10.1 - 60 mg AA/L | >60 mg AA/L | >60 mg AA/L | >60 mg AA/L | >60 mg AA/L | >60 mg AA/L | >60 mg AA/L | >60 mg AA/L | >60 mg AA/L |
| Acute #1 (48 hours) | 23 | 77 | 33.6 - 200 mg DBA/L | >200 mg DBA/L | N/A | >200 mg DBA/L | N/A | >200 mg DBA/L | N/A | >200 mg DBA/L | N/A |
| Acute #2 (48 hours) | 23 | 77 | 33.6 - 200 mg AA/L | >200 mg AA/L | N/A | >200 mg AA/L | N/A | >200 mg AA/L | N/A | >200 mg AA/L | N/A |

*6-day data/7-day data; bold indicates day test acceptability criteria were met.
> - greater than
mg DBA/L or mg AA/L – milligrams dibasic acid or adipic acid per liter
N/A – not applicable

Unless or until TVA begins use of FGD slurry thickeners, as described in the following section entitled *Use of Chemical Additives (DBA or AA) and/or Thickeners Under Normal, Expected Operating Flows and Low Flow Conditions* in this EA, TVA will meet limits of the PAF NPDES Permit and avoid aquatic toxicity by implementing **one** of the following actions, as appropriate:

- Operational controls for providing additional boiler slag (bottom ash) water to the main ash pond to reduce FGD effluent concentration at the ash pond outfall to nontoxic levels (i.e., less than or equal to 20 percent FGD effluent); or

- Baffling of the ash pond to increase retention time adequately to assimilate FGD effluent concentration at the ash pond outfall to nontoxic levels; or

- Use of other appropriate, comparably effective, operational, or technological means, which may be identified.

*Use of Chemical Additives (DBA or AA) and/or Thickeners Under Normal, Expected Operating Flows and Low Flow Conditions* – Toxicity tests indicate that under expected flows for typical plant operating conditions, addition of the proposed organic acid additives (DBA and AA) result in additional toxicity when the FGD slurry is 16 percent or greater of the JCAP discharge (Table 3-17. Chronic Test Nos. 2 and 3). This proportion of FGD relates to expected flow rates without use of FGD slurry thickeners. The $IC_{25}$ values for fathead minnows and daphnids were approximately 42 mg DBA/L and >150 mg DBA/L, respectively. The $IC_{25}$ values resulting from testing with AA were approximately 59-79 mg AA/L for daphnids and >150 milligrams per liter (mg/L) for fathead minnows. There were also some observations of depressed dissolved oxygen concentrations associated with AA in fathead minnow tests.

Initial field and laboratory studies indicated that no toxicity occurred in chronic tests with fathead minnows or daphnids exposed to simulated effluent samples comprised of 92.8 percent BAP: 7.2 percent FGD and containing 28.3 mg DBA or 28.3 mg AA/L. These results indicate that compliance with WET limits would be met under expected operational flows with Unit 3 FGD, with chemical additives in Units 1 and 2, and use of thickeners.

Under potential low flow conditions (Table 3-17. Chronic Test Nos. 4 and 5) and use of thickeners with the chemical additives, toxicity was not indicated for the addition of the proposed FGD organic acid additives at the expected concentrations. This is most likely due to the conditions that when these low flows occur with use of thickeners, the FGD slurry is estimated to be only 9.2 percent of the total JCAP discharge.

Under potential low flow conditions (Table 3-17. Acute Test Nos. 1 and 2) without thickeners, there did not appear to be acute toxicity from the addition of the proposed FGD organic acid additives at the expected concentrations. These tests imply that JCAP should not incur acute toxicity impacts if the thickeners are out of operation for a short period of time. If the FGD concentration limit is found to be below the estimated FGD concentration of 22.6 percent under this operational scenario, boiler slag (bottom ash) pumps could be used for mitigation until thickeners were back in operation.

In summary, the projected FGD discharge under expected operating conditions is near the chronic toxicity threshold for both test organisms, daphnids and fathead minnows. Initially, operational controls would be put in place to maintain the proportion of FGD to JCAP discharge to less than 20 percent. Further monitoring studies after scrubber start-up and proposed fuel switch would be conducted to confirm whether the 20 percent level is appropriate. If determined to be necessary, a subsequent revision to the Finding of No Significant Impact (FONSI), or EA and FONSI, would be made to reflect the new analyses and information.

Under normal, expected operating conditions, the proposed organic acid additives, DBA and AA, showed toxicity to test organisms below the projected effluent concentrations when thickeners are not used. If TVA implements the use of chemical additives (DBA or AA), slurry thickeners will installed and utilized. The operational commitment is as follows.

If the use of chemical additives (DBA or AA) to the scrubber slurry is implemented, TVA will also incorporate the use of thickeners to increase the efficiency of chemical additives and to reduce the volume of FGD effluent to a concentration that would not result in exceedences.

*Potential for Scrubber Operation Affecting Ammonia Removal in JCAP* – Operation of the SCRs results in small levels of ammonia being discharged into the JCAP. Current information indicates that algal and other biological activity in the JCAP will reduce the ammonia below WET limitations on DSN001. A potential concern was whether the proposed additional FGD flow would impact ammonia removals in JCAP.

Evaluation of the field study data indicates that for the level of FGD effluent inclusion (7.3 percent) in those field studies, the effect on ammonia removal in the test systems was measurable, but minor. This result must be viewed with due consideration for the fact the heavy metal concentrations in FGD pond effluents have been shown to vary substantially in long-term monitoring. As such, the observed effects of FGD inputs to ammonia removal in the full-scale ash pond may be better or less than observed in the recent study. However, the mitigation actions discussed above for the FGD system are also concurrently capable of reducing to insignificance the potential for a substantive reduction in the ash pond capacity to assimilate ammonia from the SCRs.

## 3.9. Groundwater Quality

### *3.9.1. Affected Environment*

The plant site lies within the Shawnee section of the Interior Low Plateau Province, a region characterized by maturely dissected surface development on sandstones and shales (Fenneman, 1938). The Carbondale formation (Pennsylvanian age) constitutes bedrock at the site. This formation consists of alternating sandstones, shales, limestones, and coal seams having a total thickness of about 400 feet (Lindquist and Danzig, 1997). Although no exploratory drilling at the plant site has extended below the Carbondale, regional studies (e.g., Starn et al., 1993) indicate that the Carbondale is underlain by several hundred feet of older Pennsylvanian sedimentary rocks of the Tradewater and Caseyville formations. The controlling geologic structure in the area is the east-west trending Moorman syncline. This syncline originated as a down-dropped block (graben) between two subparallel, east-northeast trending fault systems, i.e., the Pennyrile fault system, located about 3 miles southeast of the plant site, and the Rough Creek fault system, situated some 17 miles northwest of the site. The regional dip of the bedrock strata in the PAF vicinity is a few degrees to the northwest toward the axis of the Moorman syncline. Despite the presence of major fault systems in the region, the subsurface investigations of Kellberg (1959) revealed no evidence of significant faulting at the plant site.

Unconsolidated overburden materials present above bedrock include alluvial and residual soils and strip mine spoil. Past coal mining in upland areas has left the western half of the site blanketed by up to 100 feet of mine spoil consisting of a heterogeneous mixture of clay, silt, sand, coal, and rock fragments having dimensions of up to several feet. Quaternary alluvial clay and silt deposits averaging 19 feet in thickness mantle the Green River floodplain along the eastern boundary of the site (Kellberg, 1959). Unmined areas above approximately elevation 395 feet mean sea level are generally underlain by older terrace alluvium and/or by residual soils derived from weathering of the underlying bedrock.

The first occurrence of groundwater beneath the site is in the basal portion of the overburden. Natural recharge of the overburden is derived from infiltration of precipitation and from lateral inflow along the western boundary of the reservation. In addition, local artificial recharge of the overburden occurs by way of seepage from some of the larger surface impoundments associated with the plant. Horizontal groundwater gradients in the overburden generally follow surface topography with flow toward the Green River and Jacobs Creek as indicated by the groundwater level map shown on Figure 3-2. Local exceptions occur in areas adjacent to surface impoundments (e.g., the FGD waste disposal area) where gradients extend away from these impoundments in radial fashion. Groundwater movement in the underlying Carbondale formation occurs primarily through bedrock fractures and bedding planes. The Carbondale receives recharge from the overburden and from lateral inflow along the western boundary of the reservation. While horizontal groundwater gradients in the Carbondale formation are similar to those of the overburden, the groundwater potentiometric surface of the Carbondale averages about 5 feet lower than that of the overburden (Lindquist and Danzig, 1997). The downward hydraulic gradient indicated by this difference in potentiometric levels reflects the downward movement of groundwater from the overburden to the Carbondale formation.

The principal aquifers in Muhlenberg County include, in descending stratigraphic order, the Sturgis, Carbondale, Tradewater, and Caseyville formations, all of Pennsylvanian age. Development of these aquifers is generally limited to shallow domestic well supplies completed in or near aquifer outcrop areas at depths of 300 feet or less (Starn et al., 1993). The 1991 regional well inventory of Starn, et al. (1993), indicated four wells within 2 miles of the plant reservation as shown on Figure 3-2. These included one domestic well completed in the Sturgis formation, and three wells (two domestic and one industrial) developed in the Carbondale. Recent attempts to field verify well locations revealed that the two Carbondale domestic wells no longer exist.

### *3.9.2. Environmental Consequences*

*Construction Impacts – C*onstruction activities potentially affecting groundwater would be limited to excavations associated with new structural foundations and underground utilities. The new chimney, founded on bedrock at a depth of approximately 40 feet below existing grade, represents the deepest excavation required as part of FGD system modifications. The excavation is expected to penetrate approximately 35 feet of saturated alluvial terrace deposits overlying bedrock. Groundwater inflow would be controlled by short-term dewatering from the base of the excavation during foundation construction. The impact of dewatering on the productivity of neighboring off-site water supply wells would be negligible due to the limited duration of pumping and the large separation distance between these wells and the chimney site (Figure 3-2). Excavations required for construction of water supply and gypsum sluice pipelines, electrical conduits, and other structures are not expected to exceed 5 feet in depth and would not encounter significant groundwater.

These excavations would not require groundwater control and would have no effect on off-site wells. BMPs would be implemented as necessary to prevent surface water contamination from groundwater being pumped to surface.

*Operational Impacts* – The gypsum produced by the Unit 3 FGD system would be stacked in an area adjacent to the existing FGD waste disposal area (Figure 3-2). The area of the proposed Unit 3 gypsum disposal site is approximately 85 acres compared to 162 acres for the existing disposal area. FGD waste leachate characteristically contains elevated levels of total dissolved solids, chloride, sulfate, strontium, and boron. Heavy metals concentrations are also elevated in FGD leachate with cadmium, nickel, and selenium higher than the maximum contaminant levels (MCLs) established for drinking water. However, these metals have only rarely been detected at concentrations exceeding MCLs in monitoring wells located downgradient of the existing FGD disposal site, suggesting attenuation of metals during groundwater transport (Lindquist and Danzig, 1997).

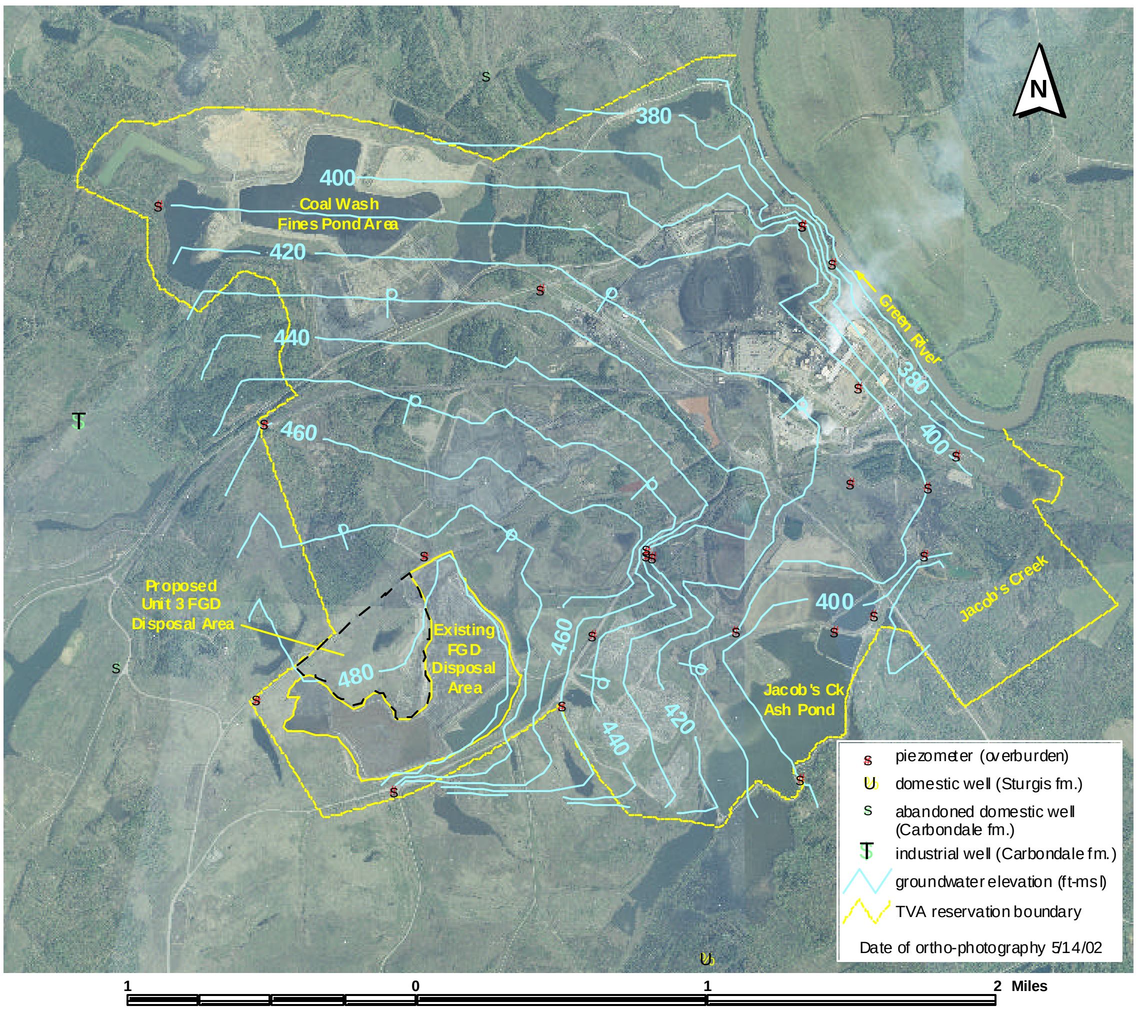
Groundwater gradients in the vicinity of the existing and proposed FGD waste disposal areas indicate that waste leachate would migrate to the north and west, and ultimately discharge into the Green River and Jacobs Creek. Off-site groundwater migration of leachate is not anticipated; therefore, no private wells would be affected. Predictions by Lindquist and Danzig (1997) suggest that groundwater discharge from all PAF waste sources to the Green River during 7Q10 low flow conditions (the minimum 7-day low flow that occurs once in 10 years) increase contaminant loadings by less than 0.4 percent for major constituents (e.g., total dissolved solids, sulfate, manganese) and by less than 0.1 percent for metals. The potential incremental increase in FGD waste leachate constituents caused by increasing the overall disposal area by 85 acres (i.e., by about 50 percent) would not significantly alter previous river loading estimates. On this basis, no significant degradation of river water quality is expected from proposed land disposal of gypsum generated by the Unit 3 FGD system.

## 3.10. Aquatic Ecology

### *3.10.1. Affected Environment*

Jacobs Creek is a small tributary of the Green River, which has experienced extensive nonpoint source pollution from strip mining in past years. In-stream habitat has been severely altered as a result of channelization, which altered the natural flow regime, leading to increased flows during rain events. The removal of substantial portions of riparian zone vegetation along the banks has removed buffer strips necessary for the prevention of erosion. Periodic drought has also impacted Jacobs Creek. Extensive flooding has resulted in the deposition of sediment.

As part of an effort to document the overall impaired condition of Jacobs Creek for the renewed PAF KPDES permit, TVA conducted a bioassessment of fish and benthic macroinvertebrate communities at five sampling stations in Jacobs Creek in 1997. Benthic samples were taken with Surber or Hess sampling gear, depending on substrate and depth. Fifty-nine species of benthic macroinvertebrates were collected, including four silt-tolerant native mussel species. The Macroinvertebrate Bioassessment Index (MBI) is based on six metrics recommended by KDOW that weigh various aspects of species diversity, abundance of various taxa groups indicative of good water quality and habitat conditions, and numbers of organisms collected. Findings are reported as a comparison to what would be expected to be found in a similar-size stream in the same ecoregion. MBI scores from




Off-site well information from Starn, et al., 1993.

**Figure 3-2. Groundwater Potentiometric Surface in Soil Overburden for August 1995**

the three sites below the ash pond discharge indicated a “poor” to “fair” benthic assemblage, for both individual sites and combined analysis. The two stations upstream of the ash pond discharge rated “poor” (TVA, 1998).

Fish were collected by seining and electrofishing (backpack and boat-mounted, depending on depth). An Index of Biotic Integrity (IBI) is an assessment of environmental quality at a stream site through application of ecologically based metrics to fish community data from the site (Karr, 1981). Twelve metrics address species richness and composition, trophic structure, abundance, and condition. Each metric reflects the condition of one aspect of the fish community and is scored against expectations under unimpaired conditions. Scores of the 12 metrics are summed to produce the IBI for the site; the IBI is then classified using the system developed by Karr, et al. (1986), rating the site from “very poor” to “excellent.” Results combining all 12 metric values for each station rated all sampling sites either as “poor or fair,” based on KDOW scoring criteria for Interior Plateau ecoregion streams. A total of 27 species (including hybrid sunfish) were collected from the five stations (TVA, 1998).

The Green River adjacent to PAF exhibits steep banks with little suitable spawning habitat for fishes. The river is very turbid due to runoff from coalfields and intensive barge traffic. Surface elevation is subject to rather drastic short-term fluctuations. The fish community is dominated by warmwater species with the exception of two coolwater species, sauger and walleye. TVA sampling from 1961-1971 collected 40 fish species (TVA, 1999).

Results of 1970 TVA sampling near PAF collected ten native mussel species (TVA, 1999). More recent sampling, focused on native mussels near the Green River navigation dams, did not include collection sites downstream of PAF but did document the presence of at least 23 mussel species within 7 river miles upstream of PAF. During this recent study, mussel abundance was found to be as high as 16 mussels per square meter; however, there was little evidence of recent recruitment (Miller, et al., 1994).

The Kentucky Department of Fish and Wildlife Resources Web site lists 107 fish species and 37 mollusk species from Muhlenberg and Ohio Counties (www.kfwis.state.ky.us/speciesInfo/CountyListSpecies). Although not all of these species would be expected to occur in the immediate vicinity of PAF, most of them could inhabit areas of suitable habitat in either the Green River or small area tributaries.

### *3.10.2. Environmental Consequences*

Under the No Action Alternative, plant surface runoff and permitted discharges would be unchanged due to scrubber construction or operation, so aquatic life would not be affected.

Under the Action Alternative, additional truck deliveries of limestone would occur, and rail delivery could occur after the PAF rail delivery system is modified. Additional truck deliveries would likely result in accumulation of additional limestone dust and debris on site roads and grounds. Impacts to aquatic life resulting from additional dust and debris entering surface waters would be insignificant. Modifications to the PAF rail delivery system are expected to be minor. Runoff from areas of disturbed soil would be controlled by implementation of BMPs to control erosion; measures would also be in place to prevent and control spills or leaks of petroleum products from equipment. Any wastewater from sources such as temporary toilet facilities would be collected and disposed of properly. These measures to control runoff and wastewater would result in insignificant impacts to aquatic life in surface water as a result of additional transportation of limestone by truck or rail.

Runoff from construction laydown areas and other outdoor construction areas, such as for gypsum sluice lines or other piping for carrying wastes to treatment ponds, would be directed through the existing system for handling storm water runoff and discharged through permitted discharges. BMPs would be implemented during soil-disturbing activities to minimize erosion transport of soil and other surface materials. Insignificant impacts to aquatic life in receiving waters are anticipated because increases in volume or sediment load to the system are expected to be slight, and existing discharge standards would be maintained. Construction wastes and scrap material generated during construction of additional piping and other structures would be controlled by implementation of routine plant measures for proper handling and disposal.

An additional intake volume of approximately 4,000 gpm is anticipated for process and equipment cooling. Modification of intake facilities and installation of additional piping would result in insignificant impacts to aquatic life with implementation of routine plant measures to control spills of petroleum and other construction materials and to dispose properly of wastes. The small increase in total water demand for the plant would not increase intake volumes or velocities appreciably, so insignificant impingement or entrainment impacts to aquatic life would result.

Operation of the scrubber would result in slight changes in discharge water chemistry and quantity. Since the discharges would be required to meet NPDES limits for chemical constituents, the proposed operational changes would not have a significant adverse impact on aquatic life in Jacobs Creek or the Green River.

## 3.11. Socioeconomics

### *3.11.1. Affected Environment*

PAF is located in Muhlenberg County, Kentucky, near the middle of a triangle formed by Hopkinsville, Bowling Green, and Owensboro. The county is largely rural, the largest cities being Central City and Greenville, with populations in 2000 of 5,893 and 4,398, respectively. There are several small places, all with fewer than 1,000 persons. The labor market area for PAF is defined to include all adjacent counties. In addition, Daviess County, where Owensboro is located, and Warren County (Bowling Green) likely would be additional sources of construction workers for any activity at the plant.

*Population* – According to the 2000 Census of Population, Muhlenberg County has a population of 31,839, only 1.7 percent higher than the 1990 Census count of 31,318. The labor market area has a population of 235,031, an increase of 5.1 percent from the 1990 count of 223,719. The population of Daviess County, a potential nonadjacent source of commuting workers, is 91,545 persons.

The population in Muhlenberg County is largely white, 94.2 percent in 2000. Most of the remaining population is black, about 4.6 percent of the total, with other nonwhite categories (including two or more races) constituting 1.1 percent of the total population. The Hispanic population, largely white, was 0.7 percent of the total. The population of the labor market area is 86.4 percent white, a somewhat smaller share than in Muhlenberg County.

*Income and Employment* – Per capita personal income in Muhlenberg County in 2000 was $19,480, about 81 percent of the state average of $24,085 and 66 percent of the national average of $29,469. The level was only slightly higher in the labor market area as a whole, $19,830 or 82 percent of the state and 67 percent of the nation. There was considerable variability, however, among the counties in the labor market area, ranging from $16,837 in Butler County to $25,158 in McLean County.

Muhlenberg County has a larger share of its workers, 18.2 percent, employed in the government sector than the state average of 14.7 percent, due in part to the employment at PAF. The county is also more agricultural than the state, but less dependent on manufacturing and on services. Due to a large military presence in Christian County, the labor market area is even more dependent on government, with 31.3 percent of its employment in the government sector.

The largest source of earnings in Muhlenberg County in 2000 was government employment, which contributed 27.1 percent of earnings, about equally divided between federal employment and state and local government employment. Other large sectors were services, 16.5 percent, and manufacturing, 11.5 percent. The labor market area, due to its significant military presence, received 43.7 percent from government, including 28.7 percent military.

With a civilian labor force of 12,638 in 2001, Muhlenberg County had an unemployment rate of 10.3 percent, well above the rate in the labor market area (7.9), the state (5.5), and the nation (4.8). This is a continuation of a pattern of the last several years dating at least as far back as 1990.

*Environmental Justice* – The population of Muhlenberg County, according to the 2000 Census of Population, is 6.3 percent minority, well below the state average of 10.7 percent and the national average of 30.9 percent. The minority share in the labor market area, at 14.5 percent, is higher than the state average but lower than the national average. This average is due largely to the population in Christian County, which is the largest county in the area and which is 31.9 percent minority, slightly higher than the national average. All of the other counties in the labor market area have minority shares smaller than the nation and the state with exception of Todd County, which has a minority share of 11.4 percent, slightly higher than the state but well below the national average.

The poverty level in 1999 in Muhlenberg County, according to the 2000 Census of Population, was 19.7 percent, higher than the state level of 15.8 percent and the estimated national level of 12.5 percent. In the labor market area, the level was 16.4 percent, somewhat lower than in Muhlenberg County. Within the labor market area, the level ranged from 15.0 percent in Christian County to 19.7 in Muhlenberg County.

### *3.11.2. Environmental Consequences of Construction*

Should the No Action Alternative be chosen, the result would be no construction activity and no change in operations at PAF. Since no action would be taken, there would be no socioeconomic or environmental justice impacts.

*Employment and Income* – If implemented, the construction period for the proposed action is estimated to last slightly more than about 2.5 years. The total number of person-months varies slightly between the potential vendors but is about 4,200 in either case. The timing of some activities also varies depending on the vendor, but in either case, the peak construction employment level is expected to be somewhat less than 300 workers. This would occur toward the end of the construction period, and would decline quickly after reaching the peak level. The buildup would be somewhat slower, reaching around 200 workers at one point and then declining temporarily before it begins to build up toward its peak. An additional 100 workers would be on site during any outage that might occur during construction. Work for which TVA is responsible, such as construction of power lines to the scrubber substation, could add a small number of workers to the peak level, depending on the timing of this work. However, the maximum increase in workers at the site is not likely to be much greater than about 400. During most of the construction period, the increase is more likely to be in or near the 100- to 200-worker range.

The local labor market area would supply many of the workers for construction. In addition, workers would be likely to commute from nearby places, such as Owensboro and Bowling Green. Workers from more distant locations are likely to move to Muhlenberg County or elsewhere in the labor market area. Some of those who move would not bring their families, but instead would travel back home on weekends or at other nonwork times. Based on experience, it is estimated that about 70 percent of these workers would live in nearby areas and therefore would not move. The remaining 30 percent, about 120 workers, would move to the general vicinity of the plant, an increase of about 0.1 percent in the labor force of the area.

Wages paid to the workers would result in an injection into the local economy of a few million dollars, a small increase in the total earnings of the area. This impact would be spread throughout the labor market area, including such places as Owensboro and Bowling Green.

*Population* – The maximum impact on population would be the 120 workers expected to move, plus whatever family they brought with them. Depending on the vendor chosen, the time period during which vendor construction employment would be at 100 or higher would be from 10 to 15 months. This could result in a large share moving with family to the area. Assuming 75 percent do so, the maximum increase in population would be around 280 persons, including possibly as many as 100 children. This would be an increase of about 0.1 percent in the population of the labor market area, and is less than 1 percent of the population of Muhlenberg County. This increase would occur for only the 10 to 15 months of construction, with fluctuations in the number during this time. The distribution of this population among counties and within counties would depend largely on the availability of housing or of sites for trailers. Locations near the site or near shopping and other amenities would generally be preferred.

*Community Services* – Impact on community services, such as schools, police, fire, and medical, would be small because of the small size of the impact on population and because of the short duration of the maximum impact.

*Environmental Justice* – PAF is located in the Block Group 1 portion of Census Tract 9607 in Muhlenberg County, Kentucky. This block group has a population of only 685 persons, according to the 2000 Census of Population. The minority population of this block group is 2.0 percent of the total, while the tract has 5.8 percent minority population. Both of these shares are below the county average of 6.3 percent and well below the state and national averages (10.7 and 30.9 percent, respectively). The Census also shows that the block group has a lower poverty level (10.3 percent) than the county (19.7 percent), state

(15.8 percent), and nation (12.5 percent), although the tract as a whole has a rate (22.2 percent) higher than the county, state, and nation. In addition, due to the nature of the work proposed and the planned work practices, no significant adverse environmental impacts are expected. Given the low population level, small minority population in the area, and low poverty rates, along with the lack of significant impacts, no disproportionate impacts to disadvantaged populations are expected, either during construction or during operation.

### *3.11.3. Environmental Consequences of Operation*

There would be an increase of about six to eight operations and maintenance workers added as a result of this action. This would constitute a small, positive impact on income and employment.

## 3.12. Transportation

### *3.12.1. Affected Environment*

PAF is served by highway, railroad, and barge modes of transportation. Portions of the existing transportation network in the vicinity of the plant are shown in Figure 3-3. The plant is located in Muhlenberg County, Kentucky, approximately 5 miles east of Drakesboro, Kentucky. Truck and automobile access to the plant is via SR 176 from U.S. Highway 431.

Transporting limestone from nearby quarries would be by truck or rail car. Truck transport would be over the highways listed in Table 3-18 along with the ADT counts. (Source: 2000-2001 traffic count information from the Kentucky Transportation Cabinet)

**Table 3-18. Average Daily Traffic Along Limestone Delivery Routes**

| | **ADT** |
|---|---|
| U.S. Highway 641 | 4,111 |
| State Road 91 | 7,172 |
| State Road 293 | 3,842 |
| Western Kentucky State Parkway | 10,947 |
| U.S. Highway 431 | 6,854 |
| State Road 176 | 2,795 |

U.S. Highway 641 from Fredonia, Kentucky, to the Parkway is a two-lane paved road with wide shoulders. SR 91 and 293 are two-lane, paved roads from Princeton to the Parkway. The Parkway is a four-lane, divided highway with wide shoulders. These highways traverse rolling countryside. U.S. Highway 431 and SR 176 are paved two-lane highways, with smooth horizontal and vertical alignment. Wide shoulders predominate on SR 176, but there are some short portions with no shoulders.

Rail routes from nearby quarries are via the Fredonia Valley Railroad (formerly the Western Kentucky Railway, LLC) from Fredonia to Princeton, the Paducah and Louisville Railroad from Princeton to Central City, and the CSX Transportation mainline from Central City to

Drakesboro and then to PAF. The Fredonia Valley Railroad and the Paducah and Louisville Railroad are short line railroads. The rail facilities located on the PAF reservation are presently unsuitable for receiving deliveries by rail. The plant track leading to the proposed on-site limestone unloading facility has suffered substantial deterioration due to poor drainage in the immediate area. In order to reestablish the capability for receiving deliveries of limestone, approximately 11,000 track feet of the rail line would need refurbishment, and a portion (approximately 6,500 track feet) would need rebuilding of the subgrade, roadbed, and drainage over and along the existing track alignment. No new areas would be disturbed, no new access would need to be developed, and changes to drainage would occur only in the area of the existing track roadbed.

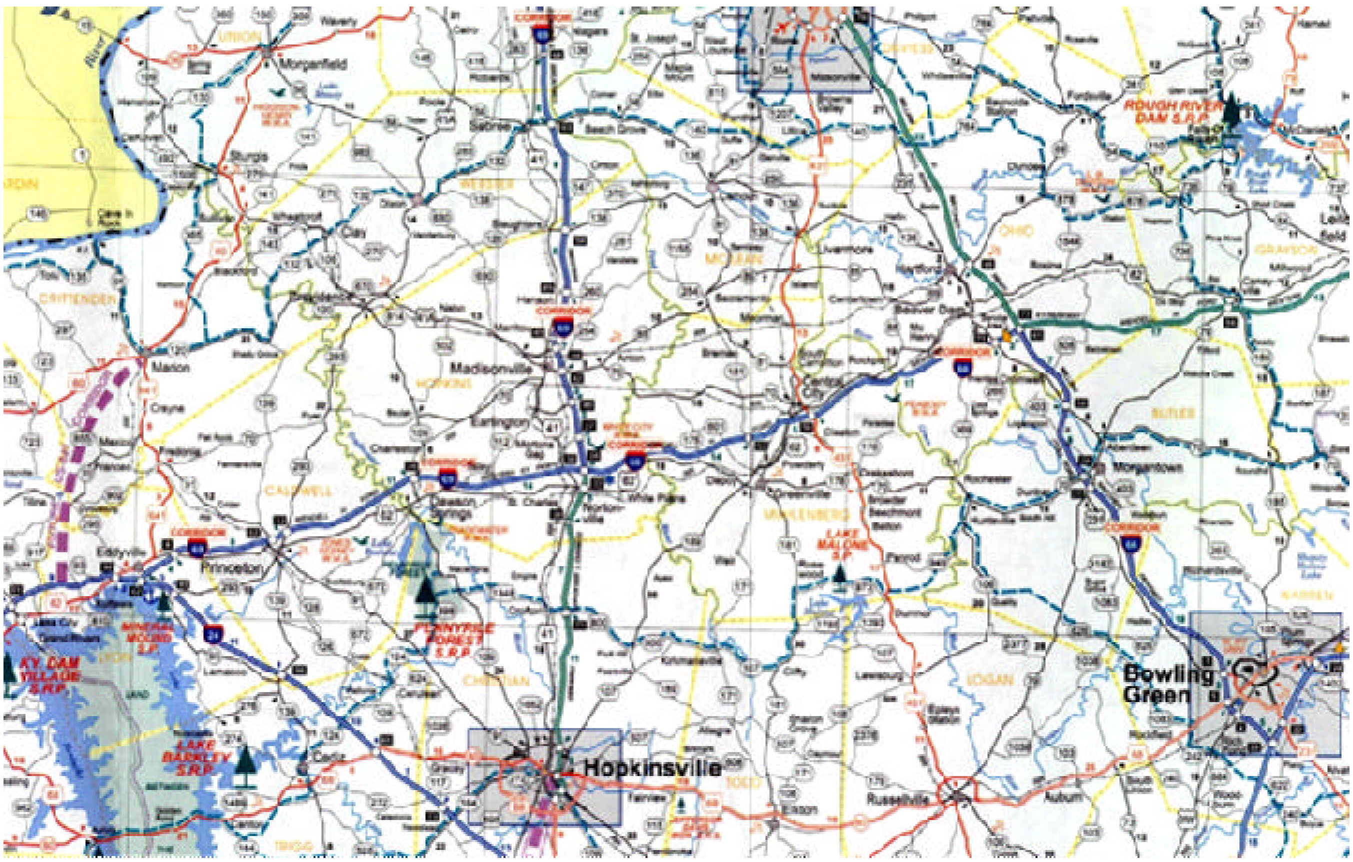



**Figure 3-3. Transportation Network in the Vicinity of Paradise Fossil Plant**

### *3.12.2. Environmental Consequences*

If no plans are undertaken to add a FGD facility at PAF, none of the roads listed above would be affected. By adding an FGD, or scrubber, facility, there would be additional road traffic generated during the construction of the facility itself or for deliveries of limestone from quarries to the plant. Although rail delivery is possible for delivery of limestone, this analysis is based on the impacts that truck delivery would have on the area roads.

Depending on the vendor selected, the construction period for the scrubber facility would span approximately 21 to 39 months, with increased employment averaging in the range of 110 to 230 workers, with a peak of 300 to 600 workers. Assuming an average ridership of 1.6 persons per vehicle, and a trip in and out each day, about 750 vehicles would be added to the local road network due to daily commuters during this period. Allowing for periodic outages that coincide with the construction period, additional workers would increase the number of vehicles to approximately 875. The ADT on SR 176 would increase to approximately 3,670 vehicles per day, or a 31 percent increase. There would also be additional traffic to the road network throughout the day in the form of construction material deliveries to the site. These deliveries would most likely be via the highway system rather than rail due to modifications currently required to the rail system at PAF.

For a more detailed analysis (Highway Capacity Analysis), the assessment of traffic effects for the project is based on the transportation planning and engineering concept of level of service (LOS). This concept addresses the quality of service, or operating conditions, provided by the roadway network, as perceived by motorists during the peak hour of traffic, typically the afternoon rush hour. Six levels of service are designated as A through F, with A being the best. In this analysis, LOS D can be viewed as an acceptable LOS of the roadway, as the conditions can be tolerable for short periods of time, or peak-hour conditions; whereas, an assessment of LOS E or F would indicate congestion and loss of service. Peak workforce was determined using existing plant employment, peak construction forces, and workforces common during an outage. Current peak hour traffic was assumed at 14 percent ADT over rolling terrain.

The results of the LOS analysis show a decrease on SR 176 from LOS C to D during the construction phase. There would be stable traffic flow, but drivers would be restricted in their freedom to select speed. In some cases, the additional traffic generated would result in a noticeable traffic flow that becomes subject to considerable and sudden variation, reduced freedom to maneuver, but operating speeds would remain tolerable for short periods of time. Most delay would be experienced at the signalized intersection of SR 176 and U.S. Highway 431 at shift changes. The people primarily experiencing the delay would be the construction commuters. Such a problem can be easily tolerated for the duration of the construction period.

U.S. Highway 431 from Drakesboro to Central City is currently operating at LOS D. During the construction period and operation period of the Unit 3 scrubber, there would be a slight drop in the existing LOS currently provided to the road users. The potential traffic impact for the construction phase of the plant would be minor. Limestone deliveries by truck for Unit 3 or all three units would not significantly alter this situation.

The employment levels would spike to peak levels in short durations, rising and falling quickly over a period of 2 to 3 months. Additional workers may be on site performing construction-related work during unit outages. In the long term, operation of the scrubber would not generate any significant additional traffic for the roads in the local area. The roads would provide for traffic flow conditions where average operating speeds would be maintained but be subject to periodic variations. These conditions can be tolerated for short periods of time.

*Limestone Rail Unloading Facilities/Operation* – A new limestone unloading facility would be located on the south side of PAF along the main plant track past the cooling towers and the existing limestone railcar-unloading hopper.

After construction is completed, operation of the Unit 3 scrubber would require limestone deliveries of approximately one 90-car unit train per week via railroad, or 63 trucks (25-ton) per day. Limestone deliveries for all three units would require two unit trains per week or 113 trucks per 5-day week. Neither delivery method would affect the capacity or LOS currently provided by the existing railroad or road network.